

FINAL REPORT

VINELAND CHEMICAL SUPERFUND SITE: PERIODIC SAMPLING – SPRING 2010 OPERABLE UNITS #3 AND #4 VINELAND, NEW JERSEY

Prepared for:



U.S. Army Corps of Engineers, Philadelphia District
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Philadelphia, Pennsylvania 19107

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December 2010

EA Project No. 62305.01

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LIST OF ABBREVIATIONS, ACRONYMS, AND UNITS

ADR	Automated Data Review
ASTM	American Society for Testing and Materials
°C	Degrees Celsius
COC	Chain of Custody
DESA	Division of Environmental Science and Assessment
DGPS	Differential Global Positioning System
EA	EA Engineering, Science, and Technology, Inc.
EDDs	Electronic Data Deliverables
EM	Engineer Manual
ft	Foot/Feet
HNO ₃	Nitric acid
in	Inch(es)
MDL	Method Detection Limit
mg/Kg	Milligram(s) Per Kilogram (ppm)
mg/L	Milligram(s) Per Liter
mL	Milliliter(s)
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD83	North American Datum 1983
NJ	New Jersey
ND	Non-detect
ppb	Part(s) Per Billion (µg/kg or µg/L)
ppm	Part(s) Per Million (mg/Kg or mg/L)
ppt	Part(s) Per Thousand (g/kg or g/L)
QA	Quality Assurance
QC	Quality Control
RL	Reporting Limit
ROD	Record of Decision
SOP	Standard Operating Procedure
µg/L	Microgram(s) Per Liter (ppb)
µm	Micrometer(s)

USACE
USEPA

U.S. Army Corps of Engineers
U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

The Vineland Chemical site is a 54-acre manufacturing facility located in Cumberland County, New Jersey (NJ) (Figure ES-1). The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles that resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including soil, sediment, and surface waters of nearby waterways such as Blackwater Branch, Maurice River, and Union Lake (Figure ES-1). Four long-term, remedial phases at the site focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). Two general areas of consideration for the study include public health and remedial actions. The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain east of Mill Road and adjacent to the site. This excavation has the potential to stir up sediments and impact the waterways downstream. A monitoring program has been initiated that includes baseline (pre-excavation) sampling, during excavation/construction sampling, and post-construction sampling to determine the status of exposure and impacts to human health exposure pathways. The first survey, the May 2006 Baseline Sampling, was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch (EA 2006a). The second survey, the November 2006 Periodic Sampling, was conducted during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities. The fourth survey, Periodic Sampling – Spring 2009, was completed in May 2009; at that time remediation activity was occurring on the west side of Mill Road. The fifth survey, Periodic Sampling – Fall 2009, was conducted in November 2009; remediation activity was being completed on the west side of Mill Road and at the Route 55 area. The sixth survey, Periodic Sampling – Spring 2010, was conducted in April and May 2010. As with the Fall 2009 sampling, remediation activity was being completed on the west side of Mill Road and at the Route 55 area.

This report presents the results of the sixth survey, Spring 2010 Periodic Sampling, that was conducted in April and May 2010. The Periodic Sampling was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and water collected at ten locations in and near waterways located adjacent to the site following the Blackwater Branch excavation activities. The April/May 2010 sampling also included additional transect sampling at the five beach locations where recreational swimming occurs during the summer bathing season. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the U.S. Army Corps of Engineers (USACE) - Philadelphia District to conduct sediment, soil, and surface water sampling at ten locations along Blackwater Branch, the Maurice River, and Union Lake. The arsenic concentration in each of the samples was measured by the U.S. Environmental Protection Agency (USEPA) Region II Laboratory located in Edison, New Jersey. The *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP) for Vineland Chemical Superfund Site* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (1994).

The following types of samples were collected and analyzed for arsenic during the Periodic Sampling – Spring 2010:

- Surficial sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) co-located with the surface water samples collected at either midstream (for the river reaches) or at greater than 200 ft from the shoreline (for the lake stations);
- Surficial sediment nearshore (shore) samples (0-0.5 ft depth increment beneath the water/sediment interface) collected 2-10 ft below the waterline;
- Surface water collected prior to sediment collection or disturbance at each site;
- Surface water collected following agitation of sediment upstream from each sampling point; and
- Beach soils collected approximately 6-10 ft above the waterline.
- Additional sediment and water samples at five beach locations; two transects with five sediment samples and four water samples per transect at each location.

Detected arsenic concentrations in water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or $\mu\text{g/L}$), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg) for arsenic in solids. The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The water, soil, and sediment results for each station (excluding the additional beach sediment samples) from the Periodic Sampling – Spring 2010 were also compared to the May 2006 Baseline Sampling results (EA 2006a), November 2006 Periodic Sampling results (EA 2007), September 2007 Post Remedial Action Sampling results (EA 2008), Periodic Sampling – Spring 2009 results (EA 2009), and Periodic Sampling – Fall 2009 results (EA 2010). Additionally, the water, soil, and sediment results from the Periodic Sampling – Spring 2010 beach stations were compared to historical arsenic data collected from five beach stations during the year 1992 and from 1994 through 1999.

ES.1 ARSENIC RESULTS

Figure ES-2 presents arsenic concentrations for each of the six sampling events: the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010.

Overall, results of the Periodic Sampling – Spring 2010 indicated that arsenic concentrations in agitated water samples exceeded the 10 $\mu\text{g/L}$ criterion at four of the eight sampling locations. The last sampling event, Periodic Sampling – Fall 2009, had exceedences in agitated water samples at three of nine locations. The highest concentration of arsenic in an agitated water sample for Spring 2010 was at Station 6 (“Bare A” Beach) with a value of 370 $\mu\text{g/L}$.

In the previous May 2006 and November 2006 Sampling events, the two stations located immediately downstream of the Vineland site, Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55) had the highest concentrations of arsenic in sediment and had the greatest number of concentrations that exceeded the Site Clean-up Level of 20 mg/kg for arsenic (Figure 3-1). Station 1 (West of Mill Road) was not sampled during the Periodic Sampling – Spring 2009, Fall

2009, and Spring 2010 events due to excavation and remediation at that location by the United States Corps of Engineers-Philadelphia District (USACE-Philadelphia). The Blackwater Branch's stream flow was also diverted at this location to allow excavation activities to be completed. Station 2 (West of Route 55), located immediately downstream of the Vineland site, had the highest concentrations of arsenic in sediment for the Spring 2009 sampling and also had the greatest number of concentrations exceeding the Site Clean-up Level of 20 ppm for arsenic (Figure 3-1). Station 2 was not sampled during Periodic Sampling – Fall 2009 and Spring 2010 due to excavation and remediation at the site; the Blackwater Branch was also diverted at this location.

Two stations located downstream from Station 2 and upstream of Union Lake had arsenic concentrations in sediments and soils that exceeded the Site Clean-up Level of 20 mg/kg. Station 3 (Blackwater Branch confluence) had a concentration of 150 mg/Kg in the shore sediment and Station 6 ("BareA" Beach) had a concentration of 160 mg/Kg in the shore sediment and 120 mg/Kg in the in-stream sediment sample.

Two stations located along Union Lake had arsenic concentrations in sediments that exceeded the Site Clean-up Level of 20 ppm. The shore sample at Station 8 (North End of Union Lake) had an arsenic concentration of 110 mg/Kg and an arsenic concentration of 410 mg/Kg in the sediment sample. The sediment sample offshore from Union Lake Beach had arsenic detected at a concentration of 330 mg/Kg. These trends in Union Lake may be attributable to the proportion of fine silt/clays in the sediment samples; arsenic is strongly sorbed onto fine particulates, including silt (Bodek et. al 1988). The arsenic that originates from upstream sources may be transported downstream via particulates which settle out in the lake depositional areas. Previous reports for the site have stated that sediment in the Maurice River and Union Lake contains a high content of organic matter (USEPA 1999). Arsenic concentrations from the five beach locations [Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach)] were either ≤ 1.1 mg/Kg or below the analytical detection limit.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 sampling events, arsenic concentrations in sediments, water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 ("BareA" Beach). In September 2007, the first exceedence of applicable criteria occurred at Station 5 (Almond Beach) in the agitated water sample and at Station 6 ("BareA" Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009 the only samples to exceed the Site Clean-up Levels were the agitated water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/kg, respectively. Periodic Sampling – Fall 2009 had criteria exceedences of agitated water at Station 7 (Sherman Avenue) and shore samples at Station 3 (Blackwater Branch confluence) and Station 6 ("BareA" Beach). The Periodic Sampling – Spring 2010 had an exceedance of 10 ppb for the agitated water sample at Station 6; shore and sediment samples at Station 6 exceeded the Site Clean-up Level of 20 ppm. Stations 4 and 5 did not exceed criterion for water, sediment, or beach samples in Spring 2010.

Arsenic results for each sampling location and matrix (sediment, water, beach soil) are presented in Figure ES-2 and summarized as follows:

Station 1 – West of Mill Rd (see Figure 3-1)

Station 1 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 2 – West of Rte 55 (see Figure 3-1)

Station 2 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)

Arsenic was detected above the USEPA Drinking Water Criterion of 10 ppb in the agitated water sample at a concentration of 58 µg/L. The shore sediment sample was detected at a concentration of 150 mg/Kg, 7.5 times above the Site Clean-up Level of 20 ppm. Arsenic was detected in the surficial mid-stream sediment sample at 3.1 mg/Kg.

Station 4 – Alliance Beach (see Figures 3-1, 3-2, and 3-8)

Arsenic was detected in the surficial mid-stream sediment sample at 2.0 mg/Kg and in the shore sediment sample at 0.84 mg/Kg. Arsenic was not detected in the water samples. In the additional beach transects, none of the arsenic concentrations exceeded the Site Clean-up Level. Two of the agitated water samples exceeded the USEPA Drinking Water Criterion.

Station 5 – Almond Beach (see Figures 3-1, 3-3, and 3-9)

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 1.2 mg/Kg. In the additional beach transects, arsenic was not detected in the sediment samples; arsenic detected in the water samples was below the USEPA Drinking Water Criterion.

Station 6 – “BareA” Beach (see Figures 3-1, 3-4, and 3-10)

Arsenic was detected in the pre-agitated water sample (8.9 µg/L) and agitated water sample (370 µg/L); the agitated water sample exceeded the USEPA Drinking Water Criterion of 10 ppb by a factor of 37. The sediment sample exceeded the Site-Clean up Level of 20 ppm by a factor of 6 with an arsenic concentration of 120 mg/Kg. The shore sample had an arsenic concentration of 160 mg/Kg exceeding the 20 ppm criterion by a factor of 8. Arsenic was not detected in the beach sample. The additional beach transect results had 8 of 10 sediment samples exceeding the Site Clean-up Level. Four water samples at the additional beach transects exceeded the USEPA Drinking Water Criterion; the four samples were agitated water samples.

Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)

Arsenic was not detected in the water sample. Arsenic was detected in the sediment sample (3.8 mg/Kg) and shore sample (3.7 mg/Kg); both were below the Site Clean-up Level of 20 ppm.

Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)

The agitated water sample exceeded the criterion of 10 ppb by a factor of 7.6 with an arsenic concentration of 76 µg/L. Arsenic was detected in both the sediment sample (410 mg/Kg) and

shore sample (110 mg/Kg). The samples exceeded the Site Clean-up Level of 20 ppm by factors of 20.5 and 5.5, respectively.

Station 9 – Union Lake Beach (see Figures 3-1, 3-7, and 3-11)

The pre-agitated water sampled exceeded the criterion of 10 ppb by a factor of 1.4 with a concentration of 14 µg/L. The agitated water sample also exceeded the criterion of 10 ppb by a factor of 12 with an arsenic concentration of 120 µg/L. Arsenic was detected in the sediment sample at a concentration of 330 mg/Kg exceeding the 20 ppm criterion by a factor of 16.5. Arsenic was detected below the 20 ppm criterion in the shore sample with a concentration of 2.3 mg/kg and in the beach sample with a concentration of 1.1 mg/Kg. In additional beach transects, arsenic was detected in all of the sediment samples but at concentrations lower than the Site Clean-up Level of 10 ppm. One agitated water sample, ULBT2-WAT2, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

Station 10 – South End of Union Lake Beach (see Figures 3-1, 3-7 and 3-12)

Arsenic was detected in the agitated water sample at a concentration of 14 ug/L; this exceeded the Drinking Water Criteria by a factor of 1.4. The sediment sample had an arsenic concentration of 9.8 mg/Kg and in the shore sample at a concentration of 1 mg/Kg; both samples were below the Site Clean-up Level of 20 ppm. Arsenic was not detected in the beach sample at this location. In additional beach transects, arsenic detected in sediment samples was below the criterion of 20 ppm. One agitated water sample, SULT2-WAT4, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

ES.2 COMPARISONS TO HISTORICAL ARSENIC DATA

During 1992 and from 1994 through 1999, water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). These data were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009 (May 2009), the Periodic Sampling – Fall 2009 (November 2009), and the Periodic Sampling – Spring 2010 (April/May) for surface water, beach soils, and surficial sediment arsenic concentrations.

Surface Water Data

Throughout the period of 1992 and 1994-1999, arsenic concentrations in surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 ppb. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Surface water data from samples collected in both May 2006 and November 2006 indicated that arsenic was not detected in the surface waters at each of these five previously sampled locations (Stations 4, 5, 6, 9, and 10), with the exception of Station 10 (South End of Union Lake Beach) in May 2006, when arsenic in the agitated water sample was equivalent to

the USEPA Drinking Criterion. However, in September 2007, there were several exceedences of the arsenic criterion in surface water. The majority of these exceedences corresponded to agitated water samples. During the May 2009 sampling only two agitated samples exceeded the arsenic criterion. The exceedences were found at Station 6 and Station 10. November 2009 sampling resulted in two agitated water samples that exceeded the arsenic criterion; Station 9 had an arsenic concentration of 1,100 µg/L and Station 10 had a concentration of 19 µg/L. Samples collected in April 2010 had four exceedences of the Drinking Water Criterion. One of the exceedences was at Station 9 in the pre-agitated sample (14 µg/L). The remaining three exceedences were in agitated samples at Stations 6, 9, and 10. The November 2009 arsenic concentration of 1,100 µg/L at Station 9 was the highest concentration measured between 1992 and 2010.

Beach Soil Data

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, 2009, and 2010 samples exceeded the Site Clean-up Level of 20 ppm.

Surface Sediment Data

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in arsenic concentration at Station 9 and Station 10 compared to May 2009 results. Surface sediment collected in April 2010 showed an increase in arsenic concentrations at Station 6 ("Bare A" Beach) compared to November 2009 results. Arsenic concentrations in surficial sediment at Station 9 were equivalent to results in November 2009.

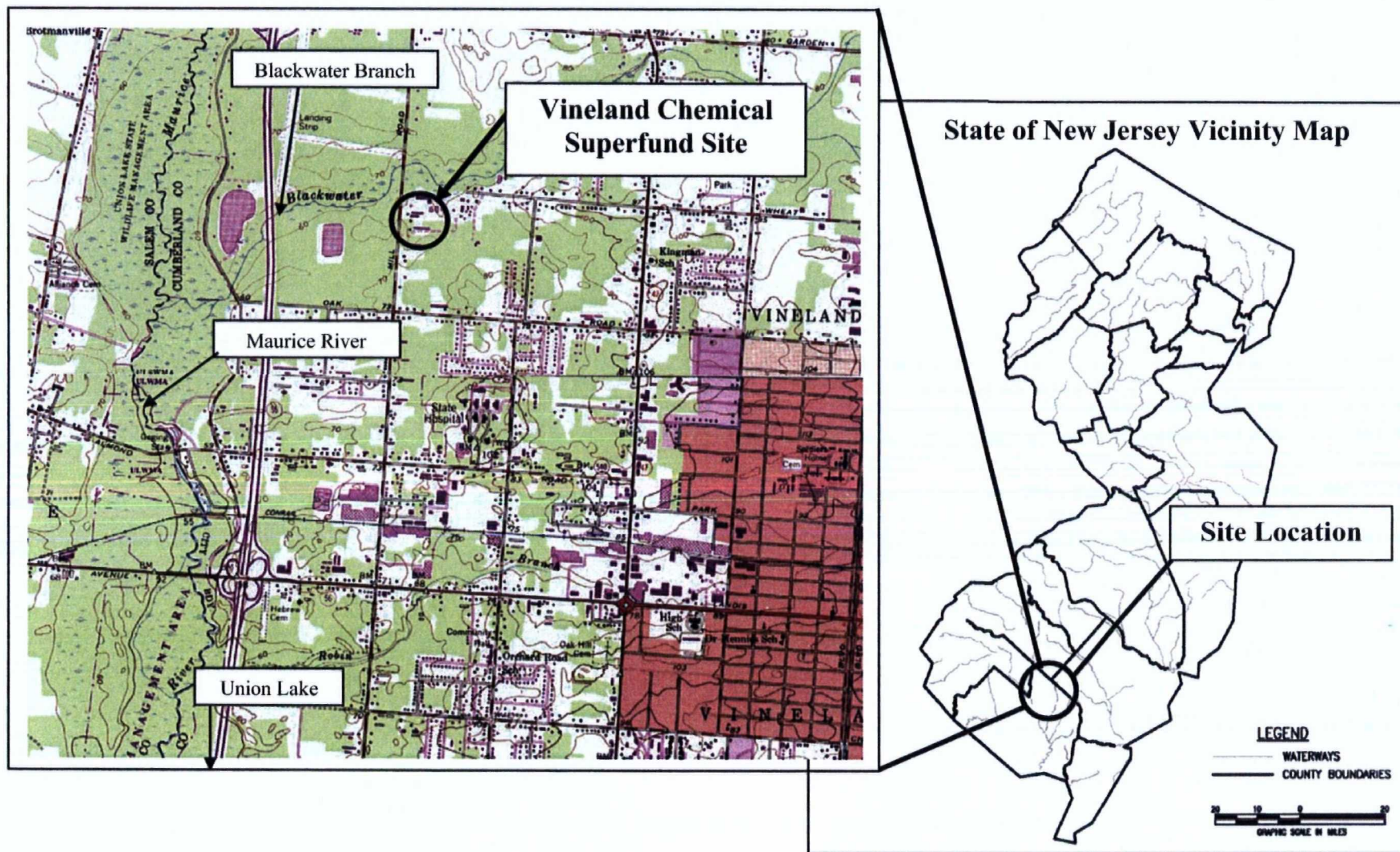
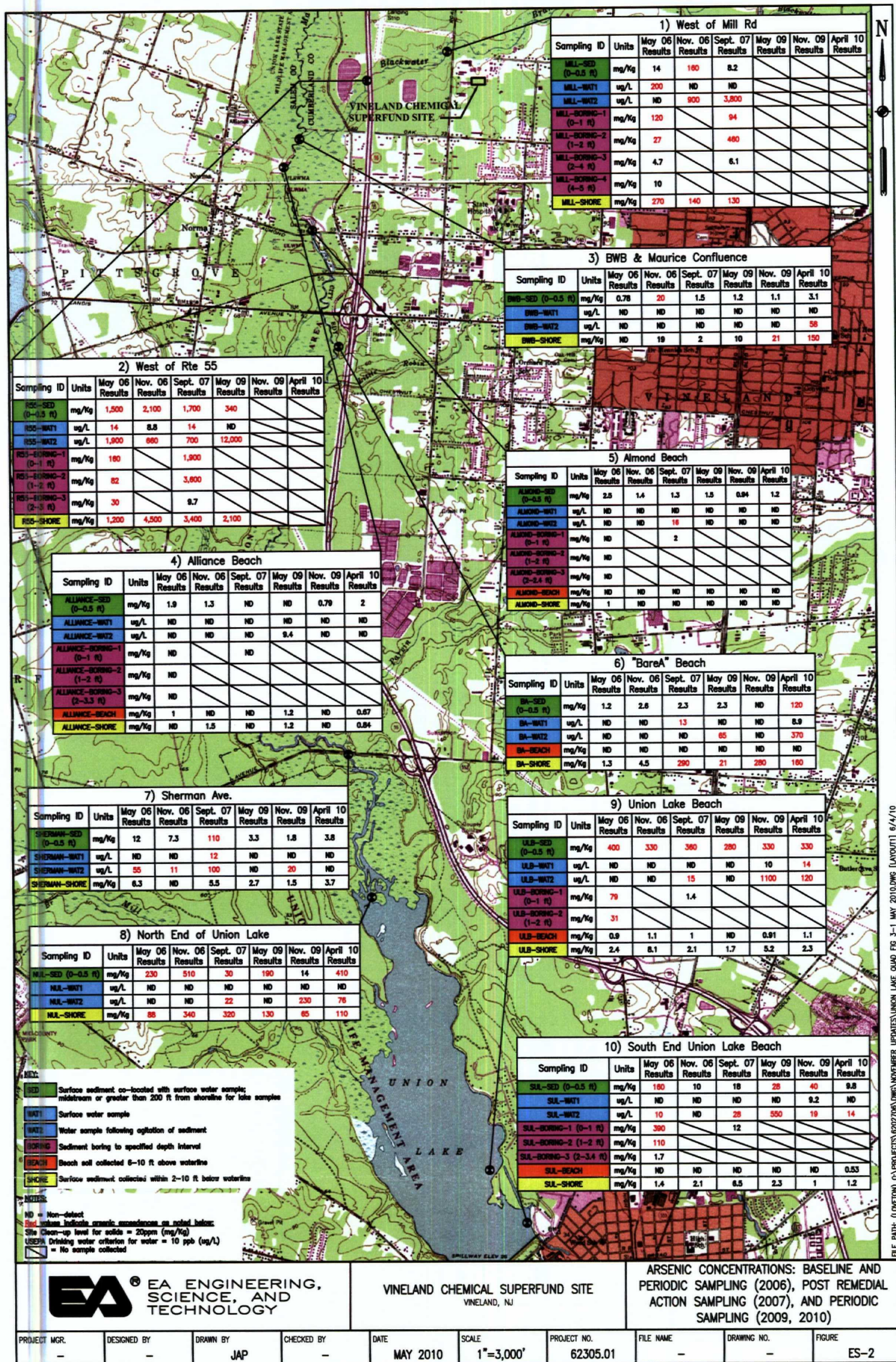


Figure ES-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ



1. INTRODUCTION

This report presents results from an arsenic survey in the vicinity of Vineland Chemical Company Superfund Site in Cumberland County, New Jersey (NJ) that was conducted for 7 locations from 6 through 8 April 2010 and one location (Sherman Avenue) on 19 May 2010 in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP) for Vineland Chemical Superfund Site* (USACE 2009). Additional sediment samples were collected at the five beach locations during the April sampling period. Two transects were sampled at each beach location with five sediment samples collected at each transect for a total of 50 beach sediment samples. In addition, water samples were collected at the end points of each transect. These data will be used to document the arsenic concentrations in nearby waterways that have been impacted by previous operations of the site following the remediation activities. Results for soils and sediments will be compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg) and results for surface water will be compared to the U.S. Environmental Protection Agency (USEPA) Drinking Water Criterion of 10 parts per billion (ppb or µg/L) for the protection of human health. These data (referred to as the Periodic Sampling – Spring 2010) represent the sixth sampling and monitoring event that was planned to assess the potential impacts of remedial activities at the site.

1.1 PROJECT BACKGROUND

Previous studies have shown that the Vineland Chemical Company Superfund Site (site) has arsenic contamination in the soils, sediments, and ground water. The site manufactured arsenic-based herbicides from 1950 to 1994 on a 54-acre site in a residential and industrial area of the City of Vineland, NJ. The site is located adjacent and upstream from nearby waterways that include the Blackwater Branch, Maurice River, and Union Lake (Figure 1-1). The soil, sediment, and water of these waterbodies have been impacted by the operations of the site. Beginning in 1982, and in response to State actions, the Vineland Chemical Company instituted some cleanup actions and modified the production process. The site clean-up is being addressed in two stages, including immediate actions and long-term remedial phases. Four long-term, remedial phases will focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain west of Mill Road to west of the Maurice River Parkway. This excavation has the potential to stir up sediments and impact the waterways downstream. Therefore, baseline (pre-excavation), during excavation, and post-remedial action sampling/monitoring is required.

Two general areas of consideration for the study include public health and remedial actions. The monitoring and sampling program is being completed to determine the status of exposure and impacts to human health exposure pathways. Results from sampling efforts will determine the extent of contamination in the surrounding areas prior to excavation activities, during excavation, and post-excavation. The first survey, the May 2006 Baseline Sampling (EA 2006a), was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch. The second survey, the November 2006 Periodic Sampling (EA 2007), was conducted

during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities east of Mill Road and adjacent to the site. The fourth survey, the Periodic Sampling – Spring 2009, was conducted during excavation for remedial action activities west of Mill Road to Route 55. The fifth survey, the Periodic Sampling – Fall 2009, and sixth survey, the Periodic Sampling – Spring 2010, were conducted during excavation for remedial action activities west of Mill Road to west of the Maurice River Parkway.

A three year period of monitoring and sampling will be implemented at the completion of Operational Unit #1 remediation activities. This will determine the impacts of remedial activities including removal of contaminated soil and sediments and pump and treat groundwater program to facilitate evaluation of further remedial action in the river areas and Union Lake.

1.2 PROJECT LOCATION

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ (Figure 1-1). The site is located in south-central NJ, approximately 40 miles from Wilmington, Delaware and approximately 35 miles from Atlantic City, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles. This resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including nearby waterways such as Blackwater Branch, Maurice River, and Union Lake.

1.3 PROJECT PURPOSE AND OBJECTIVES

Determination of arsenic concentrations in the sediments, soil, and water in the vicinity of the site is necessary in order to provide information about the environmental conditions at the site during and following the Blackwater Branch excavation activities to assess potential human exposure to arsenic and to document the extent of contamination. This sampling and monitoring effort, the Periodic Sampling – Spring 2010, documents the levels of arsenic concentrations in the sediment, soil, and water during the excavation process, and compares current (April and May 2010) arsenic concentrations to the May 2006 Baseline Sampling (EA 2006a), the November 2006 Periodic Sampling (EA 2007), the September 2007 Post Remedial Action Sampling (EA 2008), the Periodic Sampling – Spring 2009 (EA 2009), the Periodic Sampling – Fall 2009 (EA 2010), and the historic (1992 and 1994 through 1999) arsenic concentrations at the site. Additional sediment collected at the beach locations will be analyzed independently of the previous sampling efforts.

The Periodic Sampling – Spring 2010 program consisted of the following tasks:

- Sediment, soil, and water sample collection at 8 locations;
- Sediment sample collection at 5 beach locations with 2 transects per beach location consisting of 5 sediment samples per transect;

- Water sample collection at the endpoints of each additional beach transect;
- Analytical testing of sediment, soil, and water samples for arsenic concentrations;
- Data report preparation and submittal.

1.4 EXPERIMENTAL DESIGN

The executing agency for this project is the U.S. Army Corps of Engineers (USACE), North Atlantic Division, Philadelphia District. This investigation was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and water collected at ten locations in and near waterways located adjacent to the site. Previous sampling activities documented arsenic concentrations at 10 locations, but two locations that were previously sampled (West of Mill Road and West of Route 55) were not sampled in the Spring 2010 because the stream areas where these stations were previously located were realigned/re-routed as part of the ongoing remedial activity. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the USACE - Philadelphia District to conduct sediment, soil, and surface water sampling at eight locations along Blackwater Branch, the Maurice River, and Union Lake. Arsenic concentrations in each of the samples were measured by the USEPA Region II Laboratory located in Edison, NJ. The *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (1994).

1.5 REPORT ORGANIZATION

This report contains a comprehensive summary of field activities and the results of the sediment, soil and water analyses. Field sampling techniques and analytical methodologies for arsenic analyses are provided in Chapter 2 and results of the arsenic analyses are provided in Chapter 3. A summary of findings and a comparison to historical data is provided in Chapter 4. References cited are provided in Chapter 5. Appendix A presents the analytical results and accompanying Chain-of-Custody (COC) forms from the arsenic analyses; Appendix B provides a copy of the field logbook; Appendix C presents the Standard Operating Procedures (SOPs) for the laboratory analysis of arsenic; and Appendix D presents the historical arsenic data results from the years 1992 and from 1994 through 1999.

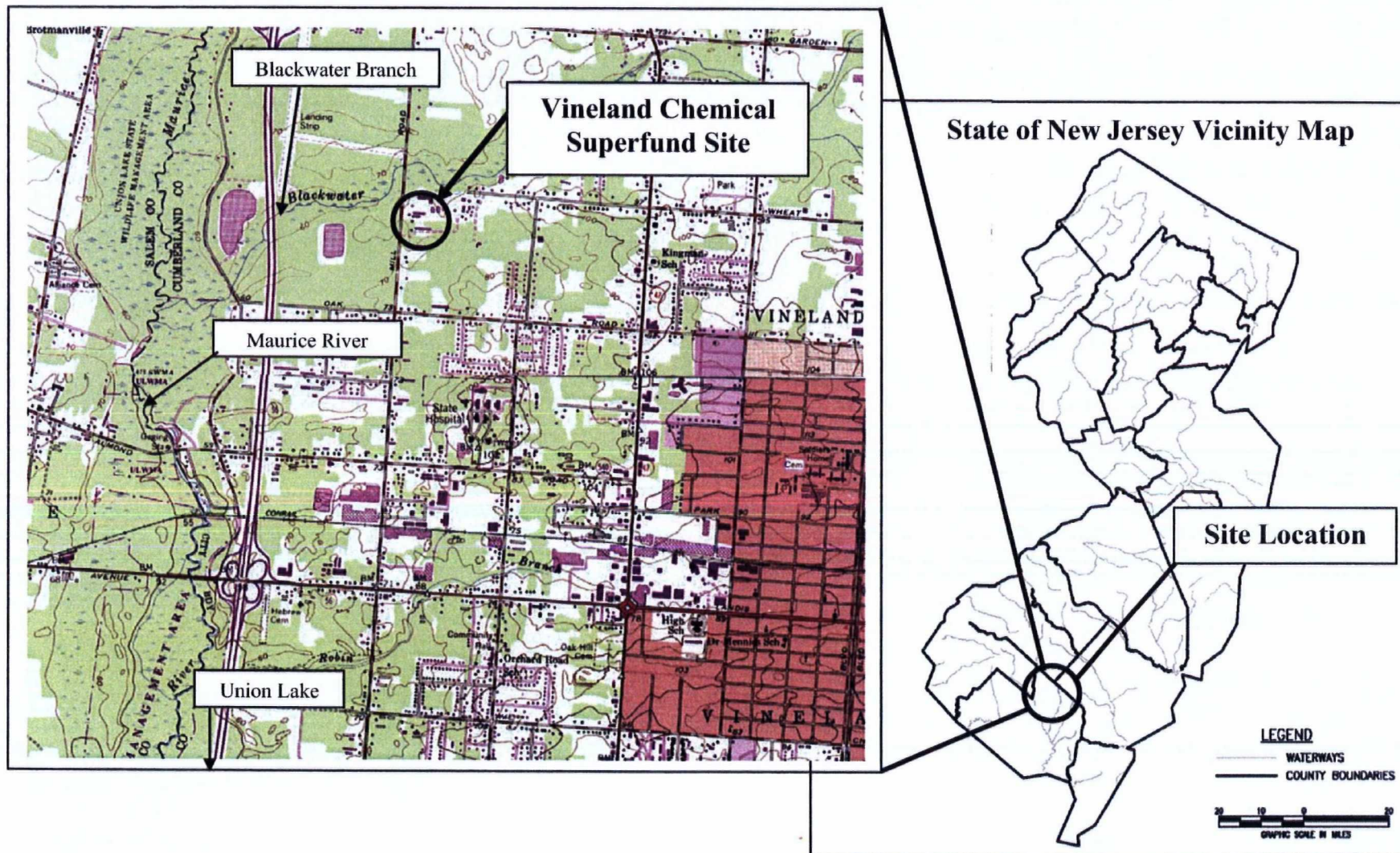


Figure 1-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ

2. METHODOLOGY

This Periodic Sampling – Spring 2010 event was carried out in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009). Collection of the water, soil, and sediment quality samples was completed on 6, 7, and 8 April 2010; due to high spring river flow, sampling at Sherman Avenue (Station 7) was not completed until 19 May 2010.

Table 2-1 summarizes the sampling requirements for the Periodic Sampling – Spring 2010. Two water samples (the first representing a sample without bottom disturbance and the second representing a sample following agitation/disturbance of the bottom sediments) were collected from each of eight stations (16 total water samples). In addition, one surficial sediment sample was collected from mid-stream (or 200 ft from offshore at lake locations) at each of eight stations, one nearshore (shore) sediment sample was collected from each of eight stations, and one beach soil sample was collected from each of five stations. Each sediment, soil, and water sample was analyzed for total arsenic concentrations. Previous sampling efforts included sediment, soil, and water samples at two locations: West of Mill Road and West of Route 55. Due to remediation activities at these locations, the Blackwater Branch was re-aligned and sediment and soil material was excavated. No samples were taken at these locations for the Spring 2010 sampling effort.

Table 2-5 summarizes the sampling requirements for ten additional beach transects that were collected concurrently with Periodic Sampling – Spring 2010. Two transects were established at each of the five beach locations. Sediment samples were collected at five locations along each transect and water samples were collected at the endpoints of each transect.

2.1 SAMPLING OBJECTIVES

The Periodic Sampling – Spring 2010 effort included surficial sediment sampling, surface water sampling, nearshore (shore) sediment sampling, and beach soil sampling. Table 2-1 provides the sampling locations and number of samples collected as part of the Spring 2010 sampling event for the project. Table 2-2 provides the sampling locations, coordinates of the sampling efforts, and sample identification. The overall objectives of the field sampling were to:

- Collect two surface water samples (mid-stream and mid-depth) of the water column (one prior to sediment disturbance and one following sediment disturbance) at each of 8 locations for arsenic analysis;
- Collect one shallow sediment sample (0-0.5 ft depth increment beneath the water/sediment interface) at 8 locations at either mid-stream (for upper sampling locations approx. 2-3 ft from shoreline) or greater than 200 ft from the shoreline (lake sampling locations) for arsenic analysis;
- Collect one shallow, nearshore (shore) sediment sample (0-0.5 ft depth increment beneath the water/sediment interface) at 8 locations approximately 2-10 ft below the waterline for arsenic analysis;

- Collect one beach soil sample at five locations approximately 6-10 ft above waterline for arsenic analysis;
- Collect and transfer sediment, soil, and water samples to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;
- Measure and record *in situ* water quality information (temperature, conductivity, salinity, dissolved oxygen, and pH) at each surface water sampling location;
- Submit equipment blanks, duplicates, and matrix spike/matrix spike duplicates for analytical testing; and
- Complete appropriate COC documentation.

The additional beach transect sampling consisted of the following :

- Conduct sediment sampling at two transects per beach location for a total of 10 transects ;
- Collect five shallow sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) at each transect.
- Collect 2 surface water samples (one prior to disturbance and one following disturbance at each transect endpoint).
- Collect and transfer sediment, soil, and water samples to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;
- Submit equipment blanks, duplicates, and matrix spike/matrix spike duplicates for analytical testing; and
- Complete appropriate COC documentation.

2.2 SAMPLING LOCATION DETERMINATION

Sampling locations for Periodic Sampling – Spring 2010 were provided by USACE-Philadelphia District and correspond to locations that were sampled in previous investigations (USEPA/ERTC 1999, EA 2006a, EA 2007, EA 2008). Sampling locations and northing and easting coordinates [NJ State Plane North American Datum 1983 (NAD83)] are provided in Table 2-2. Positioning in the field was determined using a Trimble ProXR Differential Global Positioning System (DGPS), which utilizes the United States Coast Guard Differential Beacon System to obtain sub-meter accuracy. Sample locations and a brief description are included below:

Sample Location:**Description of Sampling Location:**

1) West of Mill Rd	Along Blackwater Branch, immediately downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
2) West of Rte 55	Along Blackwater Branch, further downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
3) BWB & Maurice Confluence	At the Blackwater Branch and Maurice River confluence
4) Alliance Beach	Privately owned and located along the Maurice River and upstream of Almond Beach
5) Almond Beach	Along the Maurice River, publicly maintained beach area, approximately 100-150 ft long
6) "BareA" Beach	Along the Maurice River, downstream of Almond Beach, unmaintained public day-use area
7) Sherman Ave.	Along the Maurice River, at the Sherman Avenue Bridge
8) North End of Union Lake	In the northern section of Union Lake
9) Union Lake Beach	Privately maintained beach area, downstream of site (access at Union Lake Sailing and Tennis Club)
10) South End Union Lake Beach	In the southern section of Union Lake, north of the spillway

Sampling locations for the additional beach transects were determined in the field by EA personnel; sample spacing along the transects was dependent upon water depth at the time of sampling. Sample location coordinates, water depths, and sample distances offshore are provided in Table 3-3.

2.3 SAMPLE VOLUME REQUIREMENTS

The sample volume requirements are detailed in Table 2-1 for arsenic analyses. Arsenic analysis of sediments and beach soils required 250 grams of sediment per sample. Water samples required 250 milliliters (ml) per sample for arsenic analysis. For arsenic analyses, a total (not including field duplicates, matrix spike, and matrix spike duplicates) of eight sediment samples, eight shore samples, and five beach soil samples were collected for the Periodic Sampling – Spring 2010 effort. For arsenic analyses, 16 water samples (not including field duplicates, equipment blanks, matrix spike, and matrix spike duplicates) were collected. Fifty sediment samples and 40 water samples were collected for the additional beach transects (Table 2-5).

2.4 *IN SITU* WATER QUALITY MEASUREMENTS

Water quality measurements were recorded *in situ* at each of the nine stations using a YSI water quality probe. Measurements were recorded at the same locations where water samples were

collected for chemical analysis (mid-stream/mid-depth of the water column). The following parameters were recorded in the field log book:

- Sampling location number
- Sampling data and time
- Station depth
- Weather conditions
- Water temperature [degrees (°) Celsius]
- Conductivity (mS/cm)
- pH
- Dissolved oxygen [milligrams per liter (mg/L)]

A summary of the water quality data is provided in Table 2-3. Copies of the field logbook are provided in Appendix B.

2.5 SAMPLE COLLECTION, STORAGE, AND TRANSPORT

Upon completion of sample collection, samples were shipped via overnight delivery to the USEPA Region II, Division of Environmental Science and Assessment (DESA) Laboratory in Edison, NJ for arsenic analyses. Samples were shipped on ice and maintained at 4° Celsius. COCs accompanied the samples and documented the dates and times of sample collections for arsenic analyses are included in Appendix A. Samples were received at the DESA laboratory on 9 April and 19 May 2010 (Sherman Avenue samples) for arsenic analyses and the samples were booked and logged through the Field and Analytical Services Teaming Advisory Committee (FASTAC) process.

2.5.1 Surface Water Samples

For the Periodic Sampling – Spring 2010 surface water samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake for arsenic analysis. At each location, one surface water sample was collected as a mid-stream, mid-water column sample prior to any disturbance of bottom sediment. The second surface water sample was collected at the same location as above after disturbance of the bottom sediment. This “disturbed” sample was used to simulate potential human exposure to arsenic contaminated surface water with suspended sediment during recreational contact (i.e., beach use, wading, and swimming).

For the additional beach transect sampling, surface water samples were collected at each transect endpoint. The first location was the sampling point farthest offshore; the second location was the sampling point at the edge of the water near shore. Two water samples were collected at each point. The first water sample was collected prior to any disturbance of the bottom sediment; the second water sample was collected after disturbance of the sediment.

The “disturbance” to the sediment was conducted by wading in the water in a region 0-10 ft upstream of the sampling location for approximately 30 seconds. The “disturbed” water sample

was collected from mid-depth of the water column immediately following the disturbance of the bottom sediments.

Water samples were collected using an ISCO peristaltic pump with dedicated Tygon tubing. Water samples were transferred directly to pre-cleaned 250 ml plastic bottles preserved with nitric acid. Samples were kept on ice and maintained at 4⁰ Celsius.

2.5.2 Shallow Sediment Samples

Two types of shallow sediment samples were collected for the Periodic Sampling – Spring 2010 effort, including in-stream and nearshore (shore) sediment samples for arsenic analysis. Shallow sediment samples were also collected at 50 locations for the additional beach transect sampling. The shallow sediment samples were collected using a decontaminated stainless-steel Ponar grab sampler. Samples were homogenized in the field using stainless steel bowls and spoons immediately following sample collection. The homogenized sediment samples were then transferred directly to 4 ounce glass jars; samples were kept on ice and maintained at 4⁰ Celsius. The stainless steel bowls and spoons were decontaminated following the process described in Section 2.6.

2.5.2.1 In-Stream Sediment Samples

In-stream sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake. Sediment samples were co-located with surface water samples. The shallow sediment samples were collected from the 0-0.5 ft depth increment beneath the water/sediment interface. These samples were collected at either midstream (river locations) or at a distance of greater than 200 ft from the shoreline (lake locations).

2.5.2.2 Nearshore (Shore) Sediment Samples

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake 2-10 ft feet below the waterline. Similar to the shallow sediment sample collection, the shore sediment sample was collected from the 0-0.5 ft depth increment beneath the water/sediment interface and used to simulate potential human exposure to arsenic contaminated sediment during recreational activities/recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

2.5.3 Beach Soils

Beach soils were sampled from five locations along the Maurice River and Union Lake for arsenic analysis. Figure 2-1 provides the location of the beach sampling points. Sampling points were located at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 (“BareA” Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach).

Samples were collected at the closest shore area adjacent to sediment sampling locations and approximately 6-10 ft above the waterline using a stainless steel spoon/shovel. A grab surface soil sample from a depth of 0-0.5 ft was collected and transferred to a stainless steel bowl and

homogenized with a stainless steel spoon. The homogenized sediment samples were then transferred directly to a 4 ounce glass jar; samples were kept on ice and maintained at 4⁰ Celsius. The stainless steel shovel, bowls, and spoons were decontaminated following the process described in Section 2.6.

2.5.4 Additional Beach Transect Sediment Samples

Sediment samples were collected along 2 transects at each beach location (Alliance, Almond, Bare "A", Union Lake Beach, and South End of Union Lake Beach) for a total of 10 transects. The shallow sediment samples were collected from the 0-0.5 ft depth increment beneath the water/sediment interface using a stainless-steel Ponar grab sampler. Five sediment samples were collected along each transect; samples were spaced evenly along each transect. The transect lengths varied at each beach according to water depths. A total of 50 sediment samples were collected for the additional beach transect sampling effort.

2.5.5 Equipment Blanks

Equipment blanks were collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. A total of four equipment blanks (Tables 2-1 and 2-4) were collected for the Periodic Sampling – Spring 2010 event, which included the following:

- One blank per sampling day (three samples collected) for shallow sediment sampling/beach sampling equipment (i.e., grab sampler) and,
- One blank per sampling event/phase (one sample collected) for dedicated water collection equipment (i.e., water pump tubing).

Equipment blanks were collected by pouring deionized water, which is provided by EA's Ecotoxicology Laboratory, over sampling equipment that was decontaminated using the procedure outlined in Section 2.6. The rinsate water was placed in laboratory-prepared containers, submitted to the analytical laboratory, and tested for the same chemical parameters as the sediments and site water. Equipment blanks were sent with the surface water, sediment, and beach soil samples to the USEPA Region II DESA laboratory for arsenic analyses.

2.5.6 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and water samples and are used as measures of matrix homogeneity and sampling precision (Table 2-4 for Periodic Sampling – Spring 2010 and Table 2-5 for additional beach transects). Field duplicates were collected at a rate of 10% per sample matrix. For the Periodic Sampling a total of five duplicate samples were collected as individual co-located samples and were homogenized separately. Three field duplicate samples were collected at random locations for sediment and two field duplicate samples were collected at random locations for water. For the additional beach transects, four duplicate water samples and five duplicate sediment samples were collected.

2.5.7 Matrix Spike / Matrix Spike Duplicate Samples

A matrix spike (MS) is a field sample to which a known amount of analyte is added before sample preparation and analysis to evaluate the potential effects of matrix interference. Analyte concentrations in the spiked and unspiked sample are used to calculate percent recovery as a measure of matrix interference. A matrix spike duplicate (MSD) is a duplicate of the MS sample. MS/MSD samples were collected at a rate of 10% per sample matrix. Additional volumes of sediment and water were collected for the Periodic Sampling – Spring 2010 at random locations and included three sets of MS/MSD for sediment and soil samples and one set of MS/MSD for water samples (Tables 2-1 and 2-4). The additional beach transects included four sets of MS/MSD for water samples and five sets of MS/MSD for sediment samples (Table 2-6).

2.6 EQUIPMENT DECONTAMINATION PROCEDURES

Equipment that came into direct contact with sediment and beach soil during sampling was decontaminated prior to deployment in the field to minimize cross-contamination. This included the stainless-steel Ponar, stainless steel spoons, and processing equipment (spoons, knives, bowls, extruder, etc.). While performing the decontamination procedure, phthalate-free nitrile gloves were used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure is described below:

- Rinse equipment using site water
- Rinse with distilled or de-ionized water
- Rinse with 1 percent nitric acid (HNO_3)
- Rinse with distilled or de-ionized water

Waste liquids were contained during decontamination procedures and transferred to EA's facility in Sparks, Maryland, for disposal.

2.7 SAMPLE CHAIN-OF-CUSTODY AND DOCUMENTATION

2.7.1 Field Logbook

Field notes were recorded in a permanently bound, dedicated field logbook. A log of sampling activities and station locations were recorded in the log in indelible ink. Personnel names, local weather conditions, and other applicable field sampling program information were also recorded.

Sample location coordinates, approximate water depth, and weather conditions at each sampling location were recorded. In addition, water quality was measured and recorded at each station

using an electronic water quality monitoring instrument. Information was recorded in indelible ink. Copies of the project logbook are provided in Appendix B.

2.7.2 Sample Identification

A sample numbering system was utilized for the sediment, soil, and water samples for Periodic Sampling – Spring 2010. The sample numbering system provided communication between the sample processing operation and the laboratory performing the desired analyses. Surface water, shallow sediment, and beach soil samples were identified by site name, sample type, and date of collection. See table below for sample identification by locations:

<u>Sample Location:</u>	<u>Sample Identification:</u>
3) BWB & Maurice Confluence	BWB-
4) Alliance Beach	Alliance-
5) Almond Beach	Almond-
6) "BareA" Beach	BA-
7) Sherman Ave.	Sherman-
8) North End of Union Lake	NUL-
9) Union Lake Beach	ULB-
10) South End Union Lake Beach	SUL-

The following sample descriptors were then used to denote sample types:

- Shore – shallow sediment collected within 2-10 ft below the waterline;
- Sed – shallow sediment co-located with the surface water sample;
- Wat1 – surface water sample collected prior to sediment and/or core collection;
- Wat2 – surface water sample collected after sediment and/or core collection (following agitation and disturbance of the sediments);
- Beach – beach soil collected at the closest area adjacent to sediment sampling locations (approximately 6-10 ft above the waterline).

For example, sample BWB-Shore-*date* (MMDDYY) indicated a shallow sediment sample collected within 2 feet of the shoreline at the station located at the confluence of the Blackwater Branch and Maurice River. Each sample name was then followed with a date consisting of day, month, and year of sample collection to enable differentiation between future sampling and monitoring events that will be scheduled at the site as part of the remediation activities.

The sample numbering system for the additional beach transects used the same sample location descriptor for each of the five beach areas. Two transects were sampled at each beach with five locations at each transect for sediment samples. Four water samples were collected per transect; two pre-agitated and two post-agitated samples were collected. One set of pre- and post-agitated samples was taken at the sampling location farthest offshore and one set of pre- and post-agitated samples was taken at the location closest to shore. Following is an example of the sample identification used for sediment samples:

SULT1-1

Where SUL denotes the beach location (South End of Union Lake), T1 denotes the first transect, and -1 denotes the sample farthest offshore. The sample taken closest to shore ended in -5. The second transect at the same beach was labeled with "T2" and followed the same numbering procedure.

For the additional beach transect pre- and post-agitated water samples, the sample descriptors used the same transect numbering scheme; the last digit was replaced with WAT1, WAT2, WAT3, or WAT4. Water samples ending in WAT1 and WAT2 were the samples taken farthest offshore and WAT1 was the pre-agitated sample and WAT2 was the post-agitated. Water samples ending in WAT3 and WAT4 were taken at the location on the transects closest to shore; WAT3 denoted pre-agitated water and WAT4 indicated post-agitated water.

Field Duplicate water and sediment samples were submitted to the laboratory as blind duplicates. The site name and collection date were not designated as part of the sample identifier. Duplicate samples were designated with an identifier (i.e., DUP) and number (i.e., 1, 2, 3, etc.). For example, DUP-1 was designated as the first duplicate sample collected from a random station. DUP-2 was then designated as the next (or second) duplicate sample collected from a separate random station. Locations where duplicate samples were collected and the corresponding sample ID were recorded in the field logbook for future cross-referencing with sample laboratory results. The cross-referenced sampling locations for the field duplicates are included in Table 2-4.

MS/MSD sediment, soil, and water samples were designated with identifiers added after the site name and sample type. For example, BA-Beach-MS-*date* indicated a matrix spike beach soil sample from the station located at "BA" Beach. The following descriptors were used for matrix spike and matrix spike duplicate samples:

- MS – matrix spike sample
- MSD – matrix spike duplicate

Equipment blanks were identified by type of blank, number of each type, and date (Table 2-4). For example, PBlank-02-*date* represented the second rinsate blank for the Ponar grab sampler and bowls and spoons used for shallow sediment sampling. The following descriptors were used to denote equipment blanks:

- PBlank – Ponar grab sampler and bowls/spoons for shallow sediment samples
- TTBlank – dedicated tygon tubing blank for water sampling

2.7.3 Sample Documentation

2.7.3.1 Sample Labels

Both the individual sediment cores and the processed sediment were labeled. Sample containers for the processed sediment and water samples were labeled with the following information:

- Client name
- Project number
- Sample ID
- Station location
- Date and time of collection
- Sampler's initials
- Type of analyses required

2.7.3.2 Chain-of-Custody Records

Sediment, soil, and water samples collected in the field and at EA's processing facility were documented on a COC form. This COC accompanied the samples to the analytical and geotechnical laboratories. The COC indicated the date and time of sample collection and was signed by appropriate personnel. Copies of the COCs that accompanied the analytical testing for arsenic are provided in Appendix A.

2.7.4 Documentation Procedures

Documentation was initialed by the author and dated. Corrections to documentation were made with a single line through the error with the author's initials and date.

2.8 ANALYTICAL METHODS

Analytical testing for arsenic was conducted by the USEPA Region II DESA Laboratory Branch located in Edison, NJ.

2.8.1 Analytical Methods, Laboratory Quality Control, and Detection Limits

Samples obtained during the Periodic Sampling – Spring 2010 were analyzed for total arsenic using extraction procedure DESA SOP C-116 and analysis procedure DESA SOP C-109. Table 2-1 summarizes analytical information (total number of samples, QA/QC samples, sample volumes, sample holding times, and preservatives) for the project. The target detection limits (TDL)/screening values and laboratory reporting limits (RL) for arsenic in the water and soils were as follows:

Matrix	Target Detection Limit (TDL) / Screening Value for Arsenic	Laboratory Reporting Limit (RL) for Arsenic	Extraction/Analysis Procedure
Water	10 ppb (USEPA Drinking Water Criterion)	8 µg/L (ppb)	DESA SOP C-116 and SOP C-109
Solid	20 ppm (Site Clean-up Level)*	0.73 to 0.8 mg/Kg (ppm)	DESA SOP C-116 and SOP C-109

**The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic.*

Copies of the USEPA Region II DESA Laboratory Branch SOPs for sample digestion and for analysis of metals are provided in Appendix C, as well as laboratory Quality Control (QC) and Quality Assurance (QA) procedures.

2.8.2 Data Validation and Electronic Data Deliverables

Data validation was conducted by the USEPA Region II DESA laboratory for the arsenic analyses. A data quality and usability statement was not provided by DESA for the analytical results. Data are usable for the intended purpose except where noted by the USEPA data validation qualifiers.

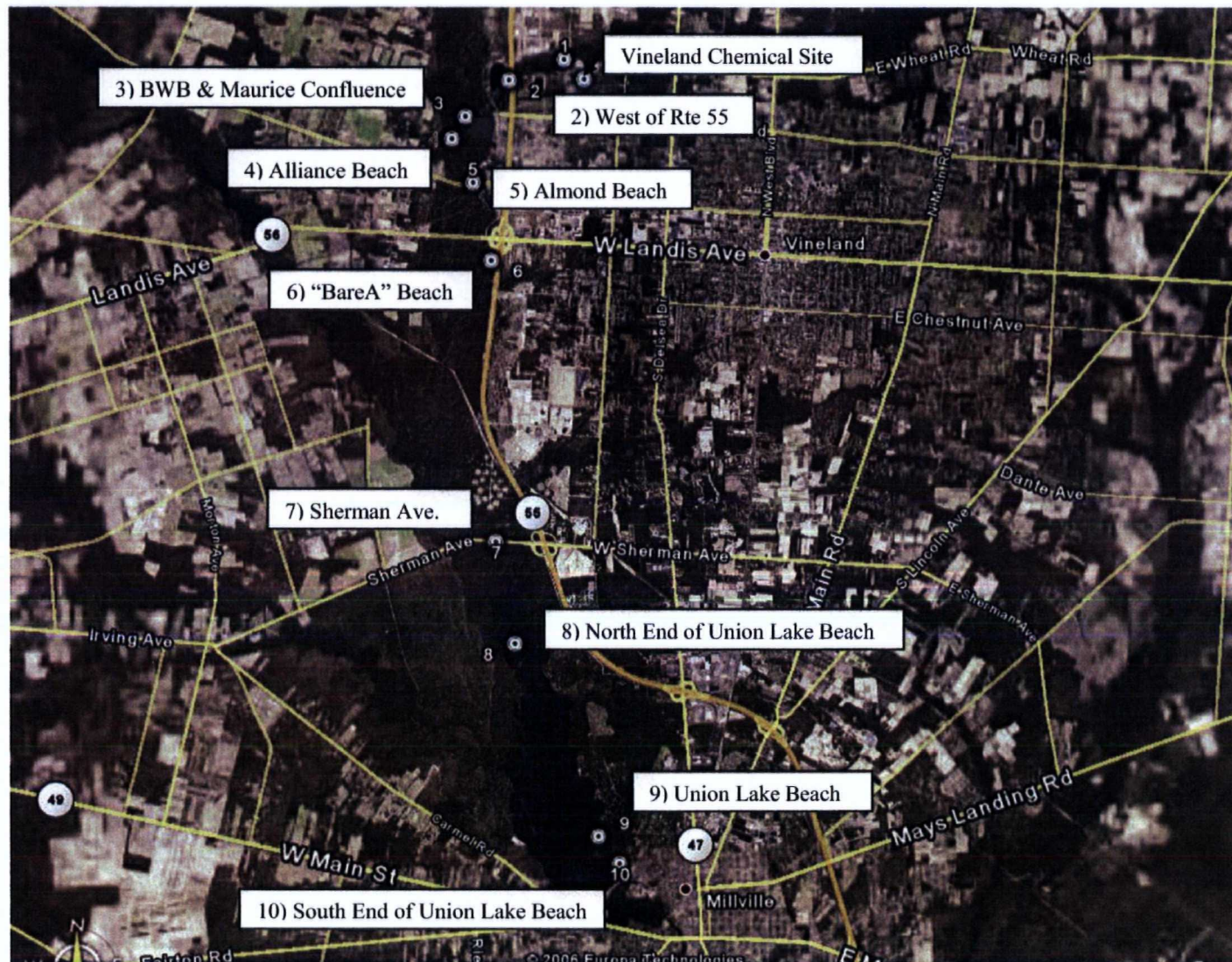


Figure 2-1. Sampling Locations in Vicinity of Vineland Chemical Superfund Site, April/May 2010

TABLE 2-1. SUMMARY OF SEDIMENT, SOIL, AND WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010
VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location (Name)	Sample Date	Type and Number of Samples			
		Sediment (sed)	Water (wat1/wat2)	Beach (beach)	Shore (shore)
		Arsenic	Arsenic	Arsenic	Arsenic
1) West of Mill Rd (MILL)	Not sampled	0	0	-	0
2) West of Rte 55 (R55)	Not sampled	0	0	-	0
3) BWB & Maurice Confluence (BWB)	4/7/2010	1	2	-	1
4) Alliance Beach (ALLIANCE)	4/7/2010	1	2	1	1
5) Almond Beach (ALMOND)	4/7/2010	1+DUP	2+DUP+MS, MSD	1+MS, MSD	1 + DUP
6) "BareA" Beach (BA)	4/7/2010	1	2+DUP	1 + MS, MSD	1
7) Sherman Ave. (SHERMAN)	5/19/2010	1	2	-	1
8) North End of Union Lake (NUL)	4/8/2010	1	2	-	1
9) Union Lake Beach (ULB)	4/6, 4/8/2010	1	2	1 + MS, MSD	1
10) South End Union Lake Beach (SUL)	4/6, 4/8/2010	1	2	1 + DUP	1
NUMBER OF SAMPLES	-	8	16	5	8
NUMBER OF QC SAMPLES	-	1	4	7	1
TOTAL NUMBER OF SAMPLES	-	9	20	12	9
Arsenic Samples:		Sediment	Water	Beach	Shore
Sample Volume		1 x 250 g	1 x 250 ml	1 x 250 g	1 x 250 g
Holding Time		6 months	6 months	6 months	6 months
Preservative/Temperature		4°C	HNO ₃ to pH <2, 4°C	4°C	4°C
Extraction/Analysis Methodologies		USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109

NOTE:

QC sample duplicates were collected and analyzed for each media at a rate of approximately 10% per sample matrix per analysis per sample event.

Sediment/soil equipment blanks= 1 blank each per day for beach soil and sediment

Aqueous equipment blank = 1 blank total for dedicated water pump/tubing

Blank Equipment Samples (5) Collected for Arsenic:

PBLANK-01, 02, 03:

Bowls and spoons used for beach sampling

TTBLANK-01:

Ponar grab sampler and bowls/spoons for shallow sediment samples

Dedicated tygon tubing blank for water sampling

**TABLE 2-2. COORDINATES FOR WATER, SOIL, AND SEDIMENT SAMPLES
COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE
APRIL/MAY 2010**

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sample Identification	Northing (ft)*	Easting (ft)*
1) West of Mill Rd	No sampling at location in April/May 2010 due to remedial activity.		
2) West of Rte 55	No sampling at location in April/May 2010 due to remedial activity.		
3) BWB & Maurice Confluence	BWB-SED	244849.1	329104.7
	BWB-WAT1, 2	244849.1	329104.7
	BWB-SHORE	244879.9	329129.9
4) Alliance Beach	ALLIANCE-SED	243399.9	328587.8
	ALLIANCE-WAT1, 2	243933.9	328587.8
	ALLIANCE-SHORE	243945.0	328576.0
	ALLIANCE-BEACH	243966.0	328540.6
5) Almond Beach	ALMOND-SED	241838.0	329512.0
	ALMOND-WAT1, 2	241838.0	329512.0
	ALMOND-SHORE	241835.6	329541.4
	ALMOND-BEACH	241844.9	329555.8
6) "BareA" Beach	BA-SED	238008.1	330366.5
	BA-WAT1, 2	238008.1	330366.5
	BA-SHORE	238004.7	330376.0
	BA-BEACH	238012.4	330401.9
7) Sherman Ave.	SHERMAN-SED	224398.4	330555.7
	SHERMAN-WAT1, 2	224398.4	330555.7
	SHERMAN-SHORE	224387.0	330561.7
8) North End of Union Lake	NUL-SED	219637.5	331304.8
	NUL-WAT1, 2	219637.5	331304.8
	NUL-SHORE	219649.1	331334.7
9) Union Lake Beach	ULB-SED	210487.8	335160.0
	ULB-WAT1, 2	210487.8	335160.0
	ULB-BEACH	210341.6	335388.5
	ULB-SHORE	210332.5	335336.4
10) South End Union Lake Beach	SUL-SED	208729.7	336396.6
	SUL-WAT1, 2	208729.7	336396.6
	SUL-SHORE	208754.9	336534.5
	SUL-BEACH	208760.3	336561.7

*Coordinates are in New Jersey State Plane (ft), NAD 83

**TABLE 2-3. *IN SITU* WATER QUALITY MEASUREMENTS COLLECTED IN VICINITY OF VINELAND
CHEMICAL SUPERFUND SITE: MAY 1999* THROUGH MAY 2010**

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Date and Time of Sample	Sample Depth	Water Temperature (degrees C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)
3) BWB & Maurice Confluence	4/7/2010 1600	Surface	21.2	0.05	9.9	6.3	0.111
4) Alliance Beach	4/7/2010 1632	Surface	21.1	0.05	10.3	6.2	0.111
5) Almond Beach	4/7/2010 1206	Surface	19.7	0.05	8.4	6.2	0.110
6) "BareA" Beach	4/7/2010 0917	Surface	18.8	0.05	6.2	6.2	0.110
7) Sherman Ave.	5/19/2010 1008	Surface	13.8	0.06	7.5	6.2	0.099
8) North End of Union Lake	4/8/2010 0941	Surface	19.4	0.06	6.3	6.5	0.133
9) Union Lake Beach	4/6/2010 1400	Surface	19.6	0.05	9.7	6.6	0.100
10) South End of Union Lake Beach	4/6/2010 1635	Surface	19.8	0.05	9.6	6.4	0.101
3) BWB & Maurice Confluence	11/18/09 1320	Surface	10.1	0.11	10.5	7.5	0.171
4) Alliance Beach	11/18/09 1401	Surface	10.3	0.12	10.7	7.5	0.175
5) Almond Beach	11/18/09 1515	Surface	10.4	0.11	10.6	7.1	0.171
6) "BareA" Beach	11/18/09 1613	Surface	10.5	0.11	10.8	7.0	0.170
7) Sherman Ave.	11/18/09 1702	Surface	11.2	0.13	10.6	7.2	0.197
8) North End of Union Lake	11/19/09 0834	Surface	11.1	0.12	10.3	7.6	0.190
9) Union Lake Beach	11/19/09 0918	Surface	11.1	0.12	10.9	7.5	0.179
10) South End of Union Lake Beach	11/19/09 0955	Surface	11.1	0.12	10.9	7.4	0.179
2) West of Rte 55	5/18/09 1110	Surface	14.9	0.07	13.4	6.0	0.117
3) BWB & Maurice Confluence	5/18/09 1335	Surface	16.1	0.06	12.8	6.4	0.097
4) Alliance Beach	5/18/09 1241	Surface	16.0	0.06	13.9	6.3	0.096
5) Almond Beach	5/18/09 1459	Surface	16.7	0.06	8.6	6.3	0.097
6) "BareA" Beach	5/18/09 1603	Surface	16.9	0.06	12.6	6.4	0.098
7) Sherman Ave.	5/18/09 1653	Surface	17.3	0.07	7.3	6.4	0.124
8) North End of Union Lake	5/19/09 0857	Surface	14.0	0.08	11.5	6.4	0.122
9) Union Lake Beach	5/19/09 0940	Surface	18.5	0.06	7.6	6.9	0.112
10) South End of Union Lake Beach	5/19/09 1017	Surface	18.7	0.06	7.0	6.8	0.112
1) West of Mill Rd	9/10/07 1730	Surface	22.3	0.06	8.9	7.6	0.121
2) West of Rte 55	9/11/07 0943	Surface	18.8	0.09	8.5	8.0	0.195
3) BWB & Maurice Confluence	9/11/07 1200	Surface	22.7	0.06	7.4	7.7	0.138
4) Alliance Beach	9/11/07 1404	Surface	22.9	0.07	7.3	7.5	0.140
5) Almond Beach	9/11/07 1538	Surface	22.8	0.07	7.4	7.2	0.140
6) "BareA" Beach	9/10/2007 1420	Surface	23.8	0.07	8.1	7.8	0.150
7) Sherman Ave.	9/10/07 1530	Surface	22.7	0.09	7.4	7.2	0.193
8) North End of Union Lake	9/12/07 1121	Surface	20.3	0.08	7.3	7.7	0.176
9) Union Lake Beach	9/12/07 1214	Surface	25.2	0.07	7.0	7.6	0.159
10) South End of Union Lake Beach	9/12/2007 1447	Surface	25.3	0.07	7.2	7.6	0.160
1) West of Mill Rd	11/02/06 0855	Surface	12.9	0.04	5.4	6.7	0.073
2) West of Rte 55	11/02/06 0940	Surface	12.8	0.05	7.6	6.6	0.089
3) BWB & Maurice Confluence	11/02/06 1047	Surface	12.3	0.04	7.6	6.1	0.068
4) Alliance Beach	11/02/06 1144	Surface	12.5	0.04	7.9	6.2	0.069
5) Almond Beach	11/01/06 1655	Surface	13.0	0.04	5.5	6.0	0.070
6) "BareA" Beach	11/01/06 1600	Surface	12.9	0.04	5.6	6.3	0.071
7) Sherman Ave.	11/01/06 1443	Surface	13.1	0.06	5.8	7.0	0.106
8) North End of Union Lake	11/01/06 1140	Surface	12.3	0.06	6.0	6.7	0.092
9) Union Lake Beach	11/01/06 1230	Surface	11.3	0.06	6.4	7.7	0.087
10) South End of Union Lake Beach	11/01/06 1300	Surface	12.9	0.06	6.8	8.3	0.093
1) West of Mill Rd	5/23/06 0840*	Surface	12.7	0.08	9.8	7.1	0.137
2) West of Rte 55	5/23/06 1808*	Surface	17.4	0.08	10.2	6.9	0.145
3) BWB & Maurice Confluence	5/25/06 0849*	Surface	17	0.05	8.8	7.2	0.098
4) Alliance Beach	5/23/06 1340*	Surface	17	0.07	9.9	6.9	0.126
5) Almond Beach	5/23/06 1453*	Surface	17.6	0.07	10.3	6.9	0.123
6) "BareA" Beach	5/23/06 1535*	Surface	17.7	0.05	10.1	6.8	0.101
7) Sherman Ave.	5/23/06 1710*	Surface	17.7	0.08	9.5	7.1	0.148
8) North End of Union Lake	5/24/06 1157*	Surface	15.8	0.07	10.0	6.9	0.116
9) Union Lake Beach	5/24/06 1318*	Surface	19	0.06	10.1	7.3	0.117
10) South End of Union Lake Beach	5/24/06 1642*	Surface	20	0.06	10.5	7.7	0.111
4) Alliance Beach	5/1999**	unknown	15.1	0.0	8.9	6.3	0.079
5) Almond Beach	5/1999**	unknown	13.5	0.0	8.7	6.4	0.077
6) "BareA" Beach	5/1999**	unknown	14.6	0.0	9.7	5.8	0.079
9) Union Lake Beach	5/1999**	unknown	16.9	0.0	9.7	5.7	0.091
10) South End of Union Lake Beach	5/1999**	unknown	15.3	0.0	9.4	5.9	0.093

**May 1999 data were referenced from (USEPA /ERTC 1999) citation

TABLE 2-4. DUPLICATE, EQUIPMENT BLANK, AND MATRIX SPIKE SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Station ID		Date Collected	Matrix
	Sample ID	Duplicate Cross-Referenced Station		
Field Duplicate	DUP-1	Almond-Shore	4/7/2010	Sediment
	DUP-2	Almond-Sed	4/7/2010	Sediment
	DUP-3	SUL-Beach	4/6/2010	Sediment
	DUP-4	BA-Wat2	4/7/2010	Aqueous
	DUP-5	Almond-Wat2	4/7/2010	Aqueous
Equipment Blank	PBlank-01	N/A	4/6/2010	Aqueous
	PBlank-02	N/A	4/7/2010	Aqueous
	PBlank-03	N/A	4/8/2010	Aqueous
	TTBlank	N/A	4/7/2010	Aqueous
Matrix Spikes (MS) and Matrix Spike Duplicates (MSD)	Almond-Wat1-MS	N/A	4/7/2010	Aqueous
	Almond-Wat1-MSD	N/A	4/7/2010	Aqueous
	BA-Beach-MS	N/A	4/7/2010	Sediment
	BA-Beach-MSD	N/A	4/7/2010	Sediment
	ULB-Beach-MS	N/A	4/6/2010	Sediment
	ULB-Beach-MSD	N/A	4/6/2010	Sediment
	Almond-Beach-MS	N/A	4/7/2010	Sediment
	Almond-Beach-MSD	N/A	4/7/2010	Sediment

**TABLE 2-5. COORDINATES AND LOCATION INFORMATION FOR SEDIMENT AND WATER
SAMPLES COLLECTED AT ADDITIONAL BEACH TRANSECTS, VINELAND CHEMICAL
SUPERFUND SITE, APRIL 2010**

Sample Location	Sample ID	Northing*	Easting*	Water Depth (ft)	Approximate Distance Offshore (ft)
4) Alliance Beach	ALLIANCET1-1	243960.7	328590.1	3	38
	ALLIANCET1-2	243962.9	328581.5	2.5	28.5
	ALLIANCET1-3	243966.4	328574.0	1.9	19
	ALLIANCET1-4	243970.7	328568.0	2.3	9.5
	ALLIANCET1-5	243976.4	328557.6	0	0
	ALLIANCET1-WAT1	243960.7	328590.1	3	38
	ALLIANCET1-WAT2	243960.7	328590.1	3	38
	ALLIANCET1-WAT3	243976.4	328557.6	0	0
	ALLIANCET1-WAT4	243976.4	328557.6	0	0
	ALLIANCET2-1	243915.0	328574.8	3	35
	ALLIANCET2-2	243917.5	328568.5	2.75	26
	ALLIANCET2-3	243919.6	328560.3	2.4	17
	ALLIANCET2-4	243922.4	328553.2	1.6	8
	ALLIANCET2-5	243925.9	328544.3	0	0
	ALLIANCET2-WAT1	243915.0	328574.8	3	35
	ALLIANCET2-WAT2	243915.0	328574.8	3	35
	ALLIANCET2-WAT3	243925.9	328544.3	0	0
	ALLIANCET2-WAT4	243925.9	328544.3	0	0
5) Almond Beach	ALMONDT1-1	241832.4	329508.3	2.7	50
	ALMONDT1-2	241833.1	329518.2	2.4	38
	ALMONDT1-3	241837.0	329525.1	2.4	26
	ALMONDT1-4	241838.7	329534.8	2.3	14
	ALMONDT1-5	241837.3	329552.5	0	0
	ALMONDT1-WAT1	241832.4	329508.3	2.7	50
	ALMONDT1-WAT2	241832.4	329508.3	2.7	50
	ALMONDT1-WAT3	241837.3	329552.5	0	0
	ALMONDT1-WAT4	241837.3	329552.5	0	0
	ALMONDT2-1	241884.6	329524.8	3.3	26
	ALMONDT2-2	241882.1	329531.4	2.65	19.5
	ALMONDT2-3	241885.8	329537.0	2.2	13
	ALMONDT2-4	241884.0	329544.5	1.5	6.5
	ALMONDT2-5	241889.4	329550.5	0	0
	ALMONDT2-WAT1	241884.6	329524.8	3.3	26
	ALMONDT2-WAT2	241884.6	329524.8	3.3	26
	ALMONDT2-WAT3	241889.4	329550.5	0	0
	ALMONDT2-WAT4	241889.4	329550.5	0	0
6) "Bare A" Beach	BAT1-1	237978.5	330371.4	3	19
	BAT1-2	237979.3	330372.8	2.5	14.5
	BAT1-3	237978.8	330375.5	2.2	10
	BAT1-4	237980.1	330380.8	2.2	5.5
	BAT1-5	237979.1	330387.7	0.6	0
	BAT1-WAT1	237978.5	330371.4	3	19
	BAT1-WAT2	237978.5	330371.4	3	19
	BAT1-WAT3	237979.1	330387.7	0.6	0
	BAT1-WAT4	237979.1	330387.7	0.6	0
	BAT2-1	238001.7	330370.2	3.6	20
	BAT2-2	238007.2	330372.3	2.6	15
	BAT2-3	238007.5	330376.3	2.5	10
	BAT2-4	238007.2	330381.1	1.7	5
	BAT2-5	238011.1	330382.7	0.7	0
	BAT2-WAT1	238001.7	330370.2	3.6	20
	BAT2-WAT2	238001.7	330370.2	3.6	20
	BAT2-WAT3	238011.1	330382.7	0.7	0
	BAT2-WAT4	238011.1	330382.7	0.7	0

TABLE 2-5. (CONTINUED)

Sample Location	Sample ID	Northing*	Easting*	Water Depth (ft)	Approximate Distance Offshore (ft)
9) Union Lake Beach	ULBT1-1	210370.1	335317.9	2.7	66
	ULBT1-2	210358.9	335323.7	2.65	53
	ULBT1-3	210351.6	335336.3	2.4	40
	ULBT1-4	210342.9	335343.9	1.9	27
	ULBT1-5	210316.3	335357.1	0	0
	ULBT1-WAT1	210370.1	335317.9	2.7	66
	ULBT1-WAT2	210370.1	335317.9	2.7	66
	ULBT1-WAT3	210316.3	335357.1	0	0
	ULBT1-WAT4	210316.3	335357.1	0	0
	ULBT2-1	210436.6	335363.1	2.8	51
	ULBT2-2	210427.5	335372.5	2.5	38
	ULBT2-3	210415.9	335380.4	2.1	25
	ULBT2-4	210403.1	335390.5	1.9	12
	ULBT2-5	210383.4	335410.9	0.6	0
	ULBT2-WAT1	210436.6	335363.1	2.8	51
	ULBT2-WAT2	210436.6	335363.1	2.8	51
	ULBT2-WAT3	210383.4	335410.9	0.6	0
	ULBT2-WAT4	210383.4	335410.9	0.6	0
10) South End Union Lake Beach	SULT1-1	208789.3	336509.1	3	42
	SULT1-2	208791.4	336516.9	2.5	32
	SULT1-3	208791.4	336525.6	1.9	22
	SULT1-4	208794.8	336534.5	1.2	12
	SULT1-5	208795.8	336546.6	0	0
	SULT1-WAT1	208789.3	336509.1	3	42
	SULT1-WAT2	208789.3	336509.1	3	42
	SULT1-WAT3	208795.8	336546.6	0	0
	SULT1-WAT4	208795.8	336546.6	0	0
	SULT2-1	208872.1	336488.9	2.9	41
	SULT2-2	208872.9	336497.0	2.3	32
	SULT2-3	208873.4	336503.5	1.9	23
	SULT2-4	208874.9	336516.1	1.4	14
	SULT2-5	208873.5	336530.1	0.4	0
	SULT2-WAT1	208872.1	336488.9	2.9	41
	SULT2-WAT2	208872.1	336488.9	2.9	41
	SULT2-WAT3	208873.5	336530.1	0.4	0
	SULT2-WAT4	208873.5	336530.1	0.4	0

* - coordinates are in New Jersey State Plane (ft), NAD83

**TABLE 2-6. SUMMARY OF SEDIMENT AND WATER SAMPLES COLLECTED AT
ADDITIONAL BEACH TRANSECTS, VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010**

Sample Location (Name)	Sample Date	Type and Number of Samples	
		Sediment	Water (wat1/wat2/wat3/wat4)*
		Arsenic	Arsenic
4) Alliance Beach (ALLIANCE)	11/18/2009	10 + 2 DUP+2 MS, 2 MSD	8 + 2 DUP+2 MS, 2 MSD
5) Almond Beach (ALMOND)	11/18/2009	10 + 2 DUP+2 MS, 2 MSD	8+ 2 DUP+2 MS, 2 MSD
6) "BareA" Beach (BA)	11/18/2009	10 + DUP+MS, MSD	8
9) Union Lake Beach (ULB)	11/19/2009	10	8
10) South End Union Lake Beach (SUL)	11/19/2009	10	8
NUMBER OF SAMPLES	-	50	40
NUMBER OF QC SAMPLES	-	10	12
TOTAL NUMBER OF SAMPLES	-	60	52
Arsenic Samples:		Sediment	Water
Sample Volume		1 x 250 g	1 x 250 ml
Holding Time		6 months	6 months
Preservative/Temperature		4°C	HNO ₃ to pH <2, 4°C
Extraction/Analysis Methodologies		USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109

NOTE:

QC sample duplicates were collected and analyzed for each media at a rate of approximately 10% per sample matrix per analysis per sample event.

* - Wat1 and Wat3 represent pre-agitated water samples; Wat2 and Wat4 represent post-agitated water samples

3. RESULTS

The Periodic Sampling – Spring 2010 results for each station and sampling matrix are presented in Figure 3-1. Arsenic results by individual station locations are presented in Figures 3-2 through 3-7. Results for the additional beach transects are presented in Figures 3-5 to 3-9. Detected arsenic concentrations in water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or $\mu\text{g/L}$), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg). The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The laboratory report and the accompanying COC forms are provided in Appendix A. Appendix C provides the SOPs for the laboratory analyses.

3.1 WATER

3.1.1 *In Situ* Water Quality

Water quality measurements were recorded *in situ* at each of the eight locations where water samples were collected for chemical analysis (mid-stream/mid-depth of the water column) (Table 2-3). Table 2-3 also includes *in situ* water quality data collected during the November 2009 (EA 2010), May 2009 (EA 2009), September 2007 (EA 2008), November 2006 (EA 2007), May 2006 (EA 2006a), and May 1999 (USEPA/ERTC 1999) field collections at the site for comparison. The *in situ* water quality results were within the expected range of parameters for a freshwater system in New Jersey. Water temperature ranged from 13.8 to 21.2 degrees Celsius, salinity ranged from 0.05 to 0.06 parts per thousand (ppt), dissolved oxygen ranged from 6.2 to 10.3 mg per liter (mg/L), pH ranged from 6.2 to 6.6, and conductivity ranged from 0.099 to 0.111 mS/cm .

3.1.2 Surface Water (Periodic Sampling - Spring 2010)

Surface water samples were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). At each location, one surface water sample was collected prior to any disturbance of bottom sediment (referred to as sample one – Wat1) and the second surface water sample was collected at the same location as above after disturbance of the bottom sediment (referred to as sample two – Wat2), intended to simulate potential human exposure to arsenic during recreational contact. Therefore, a total of 16 surface water samples were collected from eight locations in the vicinity of the site. Six of the 16 surface water samples analyzed had detected concentrations of arsenic that were above the 10 ppb ($\mu\text{g/L}$) USEPA Drinking Water Criterion for arsenic. Five of the exceedences occurred in the agitated water samples, with arsenic concentrations of 58 $\mu\text{g/L}$ at Station 3 (Blackwater Branch confluence), 370 $\mu\text{g/L}$ at Station 6 (“Bare A” Beach), 76 $\mu\text{g/L}$ at Station 8 (North End of Union Lake), 120 $\mu\text{g/L}$ at Station 9 (Union Lake Beach), and 14 $\mu\text{g/L}$ at Station 10 (South End of Union Lake). The pre-agitated sample (Wat1) at Station 9 (Union Lake Beach) had an arsenic concentration of 14 $\mu\text{g/L}$ which exceeded the USEPA Drinking Water Criterion for arsenic. Station 6 had a detected concentration of arsenic below the 10 ppb USEPA Drinking Water Criterion in the pre-agitated (Wat1) samples. The remaining stations did not have detected concentrations of arsenic (Table 3-1). The agitated water field duplicate taken at Station 6 had

an exceedance with an arsenic concentration of 590 µg/L. The second agitated water field duplicate taken at Station 5 (Almond Beach) had a non-detect of arsenic (Table 3-1).

3.1.3 Surface Water (Additional Beach Transects)

Surface water was collected from five beach locations consisting of two transects per beach. At each transect water with sample names ending in WAT1 and WAT2 was collected at the sampling location located farthest offshore; a second set of water samples, with sample names ending in WAT3 and WAT4, was collected at the sampling location located near the shoreline. Sample names ending with WAT1 and WAT3 refer to pre-agitated samples; sample name ending with WAT2 and WAT4 were post-agitated samples. Table 3-3 and Figures 3-5 to 3-9 present the results of sampling.

A total of 40 water samples were collected for the additional beach transect sampling effort. Arsenic was detected in eight of the 40 samples; all detected concentrations were in agitated samples. Arsenic concentrations in the eight samples exceeded the USEPA Drinking Water Criterion of 10 ppb. The samples with arsenic detections included Station 4 (Alliance Beach), Station 6 ("Bare A" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake). Detected arsenic concentrations ranged from 11 µg/L to 150 µg/L; four of the eight exceedances occurred at Station 6. None of the pre-agitated water samples had any detected arsenic.

3.2 SEDIMENT AND SOIL

3.2.1 Shallow Sediment (Periodic Sampling – Spring 2010)

Two types of shallow and nearshore (shore) sediment samples were collected, including in-stream and nearshore (shore) sediment samples (Figures 3-2 through 3-7). The results are presented in the following paragraphs and Table 3-2. The shallow sediment samples were intended to simulate potential human exposure to arsenic contaminated sediment during recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

3.2.1.1 In-Stream Sediment

In-stream sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). Arsenic was detected in the shallow sediment samples at each of the eight locations, ranging from 1.2 mg/Kg to 410 mg/Kg (Table 3-2). At three locations, in-stream arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm (mg/Kg): Station 6 ("Bare A" Beach) (120 mg/Kg), Station 8 (North End of Union Lake Beach) (410 mg/Kg), and Station 9 (Union Lake Beach) (330 mg/Kg).

3.2.1.2 Nearshore (Shore) Sediment

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake, 2-10 ft below the waterline, representing the 0-0.5 ft depth increment beneath the water/sediment interface (Figures 3-1 through 3-7). Arsenic was detected in seven of the eight shore sediment samples, ranging from 0.84 mg/Kg to 160 mg/Kg (Table 3-2). At three locations, nearshore arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm for arsenic in solids. Arsenic exceeded the 20 ppm criterion at Station 3 (Blackwater Branch confluence) (150 mg/Kg), Station 6 ("Bare A" Beach) (160 mg/Kg), and Station 8 (North End of Union Lake) (110 mg/Kg). Arsenic was not detected in shore sediment at Station 5 (Almond Beach).

3.2.2 Beach Soils

Beach soils were sampled from a total of five locations along the Maurice River and Union Lake (Figures 3-2, 3-3, 3-4, and 3-7). Arsenic was only detected at three of the five beach locations; none of the detected concentrations exceeded the Site Clean-up Level of 20 ppm for arsenic in solids (Table 3-2). Arsenic was not detected in beach soils at Station 5 (Almond Beach) and Station 6 ("Bare A" Beach).

3.2.3 Sediment (Additional Beach Transects)

Table 3-4 and Figures 3-5 to 3-9 show the results of sediment sampling at the five beach locations. Two transects were sampled at each beach location. Five sediment samples were collected at each transect for a total of 50 additional beach transect sediment samples. Of the 50 sediment samples collected, arsenic was detected in 42 samples. Arsenic was detected at concentrations below the Site Clean-up Level of 20 ppm in 34 samples. Eight samples had arsenic detected at concentrations above the Site Clean-up Level of 20 ppm; arsenic concentrations exceeding 20 ppm ranged from 26 mg/Kg to 450 mg/Kg. All of the samples exceeding 20 ppm were located at Station 6 ("Bare A" Beach).

3.3 QA/QC RESULTS (Periodic Sampling – Spring 2010)

The results for the QA/QC samples, including equipment blanks and field duplicates are provided in Tables 3-1 and 3-2, respectively, and are discussed in the following subsections.

3.3.1 Equipment Blanks

Arsenic was not detected at concentrations above the Method Detection Limit (MDL - 8 µg/L) in any of the equipment blanks (Table 3-1). Therefore, it is unlikely that any contamination can be attributed to sampling equipment or collection and handling.

3.3.2 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and water samples.

Relative percent differences (RPD) were calculated for field duplicate samples that had detected concentrations of arsenic. Following the protocol defined in Worksheet 12 of the *UFP/QAPP* (USACE 2009), the RPD was calculated for DUP-2 and DUP-4. RPDs were not calculated for duplicates and co-located samples with non-detect results. According to the *UFP/QAPP* (USACE 2009), the measurement performance criterion for sediment samples and aqueous samples was 25% RPD (QAPP Worksheets 12-1 and 12-2).

The RPD for DUP-2 was less than 25%. The RPD for DUP-4 was 45.8% which was out of compliance with the measurement performance criteria. The difference in arsenic concentrations between DUP-4 and BA-WAT2 is due to the variability in collecting post-agitated water samples (manually disturbing the sediment to simulate potential human exposure) thus resulting in a RPD value above the 25% performance criterion.

<u>Type of Sample</u>	<u>Duplicate # / Result</u>	<u>Matching Sampling ID / Result</u>	<u>RPD for detected analytes</u>
Sediment	DUP-1/(U)	Almond-Shore (U)	NC
Sediment	DUP-2/(1.0 mg/Kg)	Almond-Sed (1.2 mg/Kg)	18.2%
Sediment	DUP-3/(U)	SUL-Beach (0.53 mg/Kg)	NC
Aqueous	DUP-4/(590 µg/L)	BA-Wat2 (370 µg/L)	45.8%
Aqueous	DUP-5/(U)	Almond-Wat2 ((U)	NC

U = non-detected arsenic concentration

NC = not calculated due to non-detected results

3.3.3 MS/MSD Samples

The Laboratory's established QC criteria were met for MS and MSD samples, including aqueous samples, soil samples, and sediment samples. These data were validated by the USEPA Region II DESA Laboratory.

3.4 QA/QC RESULTS (Additional Beach Transects)

3.4.1 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and water samples. Following the protocol described in Section 3.3.2 RPD values were calculated field duplicate samples that had detected concentrations of arsenic.

The RPD value for SED-DUP5 and its matching sample were below the measurement performance criterion of 25%. SED-DUP4 and WATER-DUP2 were outside of the measurement performance criterion. The arsenic concentrations detected in SED-DUP4 and AlmondT2-5 were close to the average reporting limit for sediment samples. The small difference in sample results translated to a high RPD. However, due to the heterogeneity of sediment, the RPD is not a significant deviation and the sample results are still acceptable. The arsenic concentrations for SED-DUP4 and AlmondT2-5 were well below the Site Clean-up Level of 20 ppm.

The difference in arsenic concentrations between WATER-DUP2 and AllianceT2-Wat4 is due to the variability in collecting post-agitated water samples (manually disturbing the sediment to simulate potential human exposure) thus resulting in a RPD value above the 25% performance criterion.

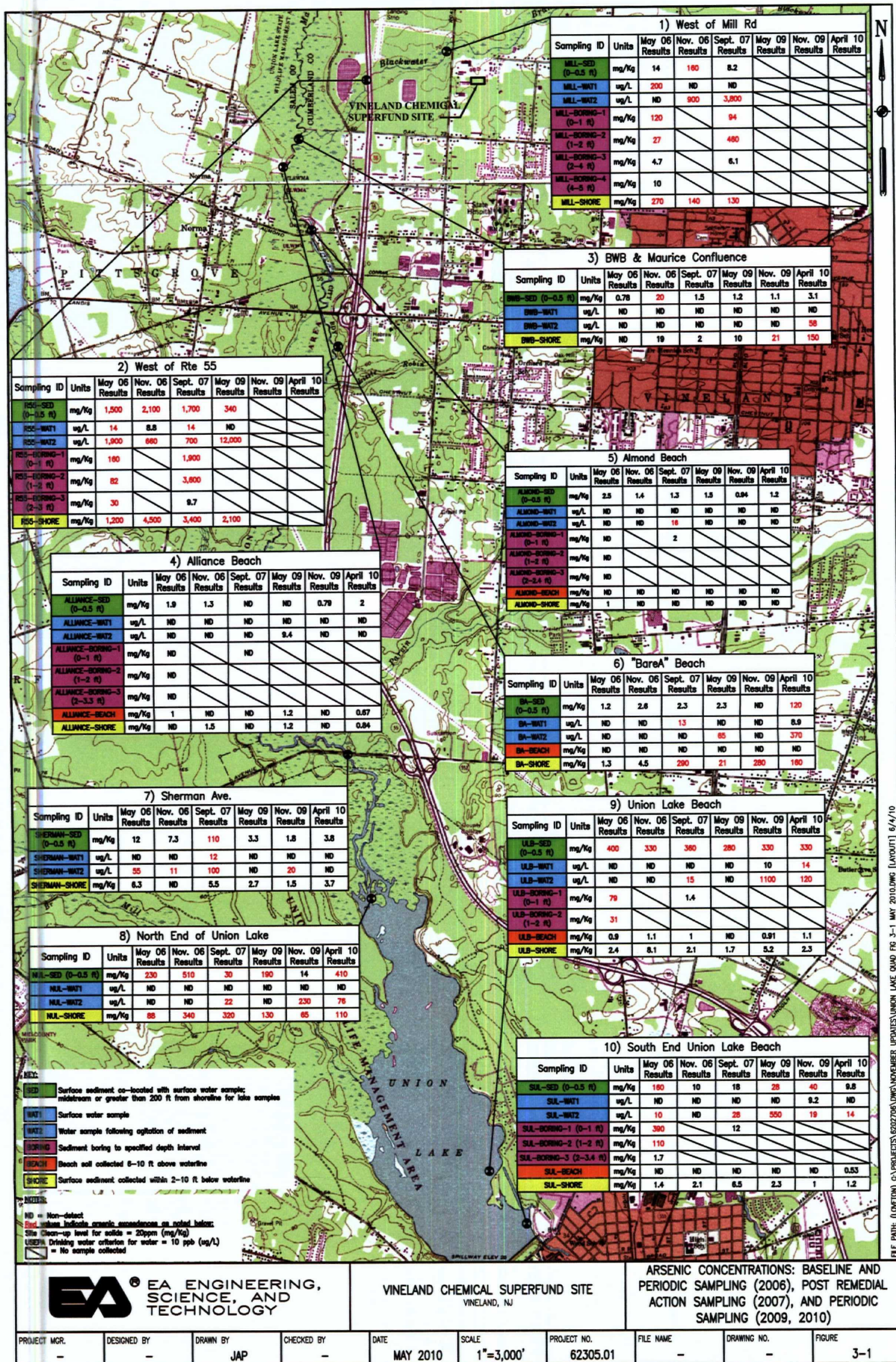
<u>Type of Sample</u>	<u>Duplicate # / Result</u>	<u>Matching Sampling ID / Result</u>	<u>RPD for detected analytes</u>
Sediment	SED-DUP1 (U)	AllianceT1-5 (U)	NC
Sediment	SED-DUP2 (0.55 mg/Kg)	AllianceT2-5 (U)	NC
Sediment	SED-DUP3 (U)	AlmondT1-5 (U)	NC
Sediment	SED-DUP4 (1.1 mg/Kg)	AlmondT2-5 (1.5 mg/Kg)	-30.8%
Sediment	SED-DUP5 (29 mg/Kg)	BAT1-5 (26 mg/Kg)	10.9%
Aqueous	WATER-DUP1 (U)	AllianceT1-Wat4 (U)	NC
Aqueous	WATER-DUP2 (8.3 µg/L)	AllianceT2-Wat4 (12 µg/L)	-36.4%
Aqueous	WATER-DUP3 (U)	AlmondT1-Wat4 (U)	NC
Aqueous	WATER-DUP4 (U)	AlmondT2-Wat4 (U)	NC

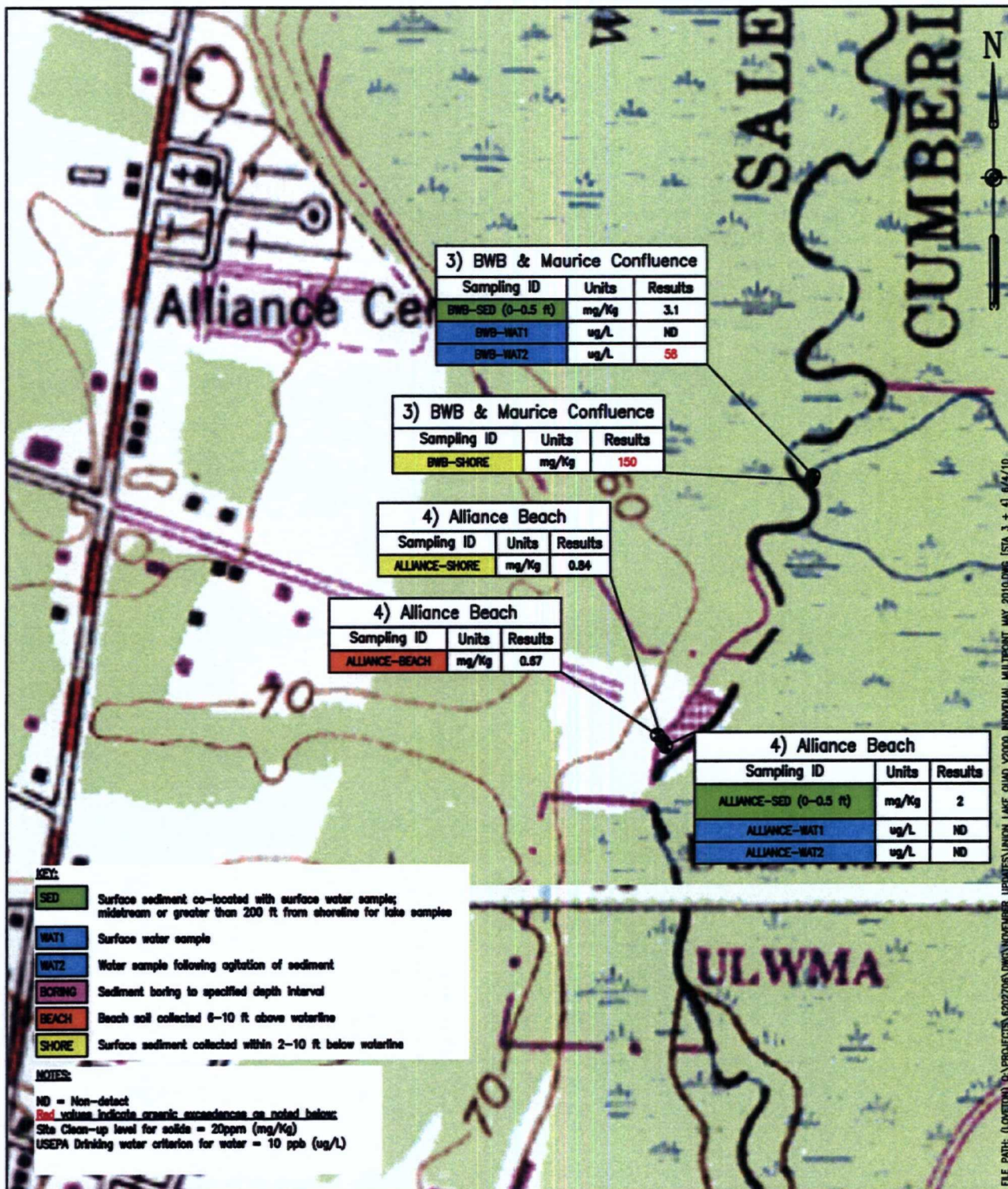
U = non-detected arsenic concentration

NC = not calculated due to non-detected results

3.4.2 MS/MSD Samples

The Laboratory's established QC criteria were met for MS and MSD samples, including aqueous samples and sediment samples. These data were validated by the USEPA Region II DESA Laboratory.



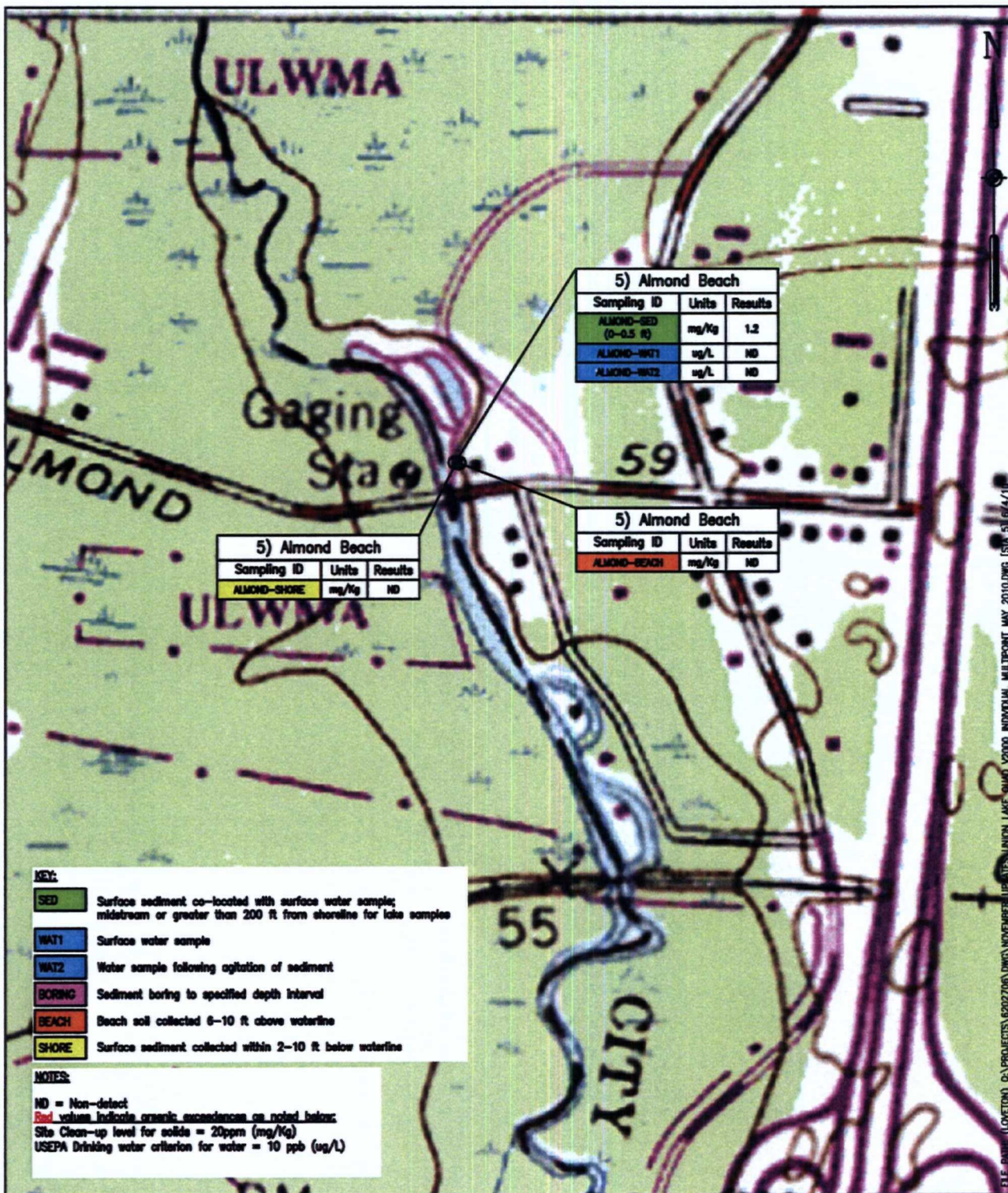


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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING--SPRING 2010
SAMPLE LOCATIONS
3) BWB & MAURICE CONFLUENCE
AND 4) ALLIANCE BEACH

PROJECT MGR -	DESIGNED BY -	DRAWN BY MP	CHECKED BY -	SCALE 1"=500'	DATE 5-5-10	PROJECT NO 62305.01	FIGURE 3-2
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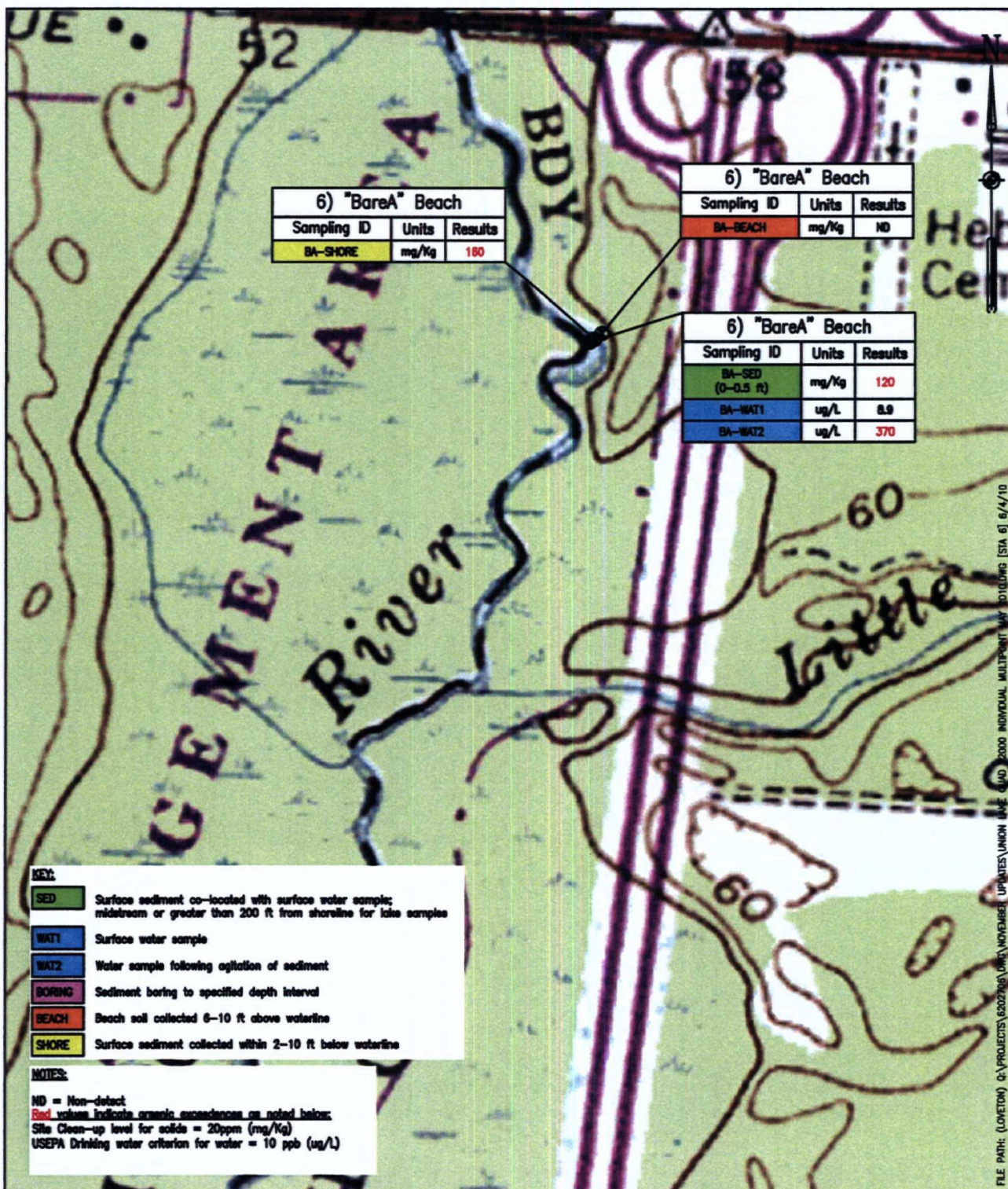
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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING--SPRING 2010
SAMPLE LOCATION
5) ALMOND BEACH

PROJECT MGR -	DESIGNED BY -	DRAWN BY MP	CHECKED BY -	SCALE 1"=500'	DATE 5-5-10	PROJECT NO 62305.01	FIGURE 3-3
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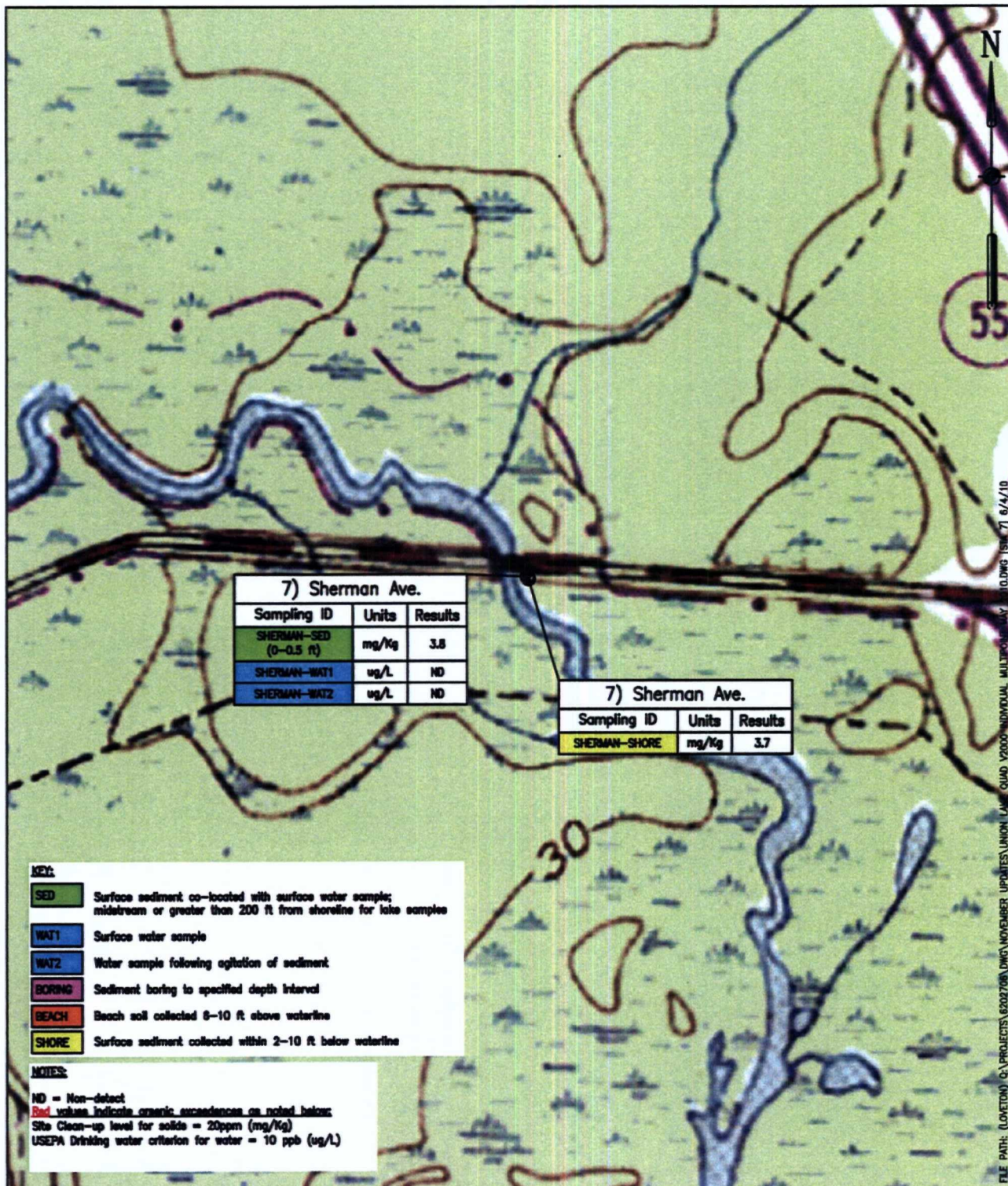


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PERIODIC SAMPLING—SPRING 2010
SAMPLE LOCATION
6) "BARE A" BEACH

PROJECT MGR —	DESIGNED BY —	DRAWN BY MP	CHECKED BY —	SCALE 1"=500'	DATE 5-5-10	PROJECT NO 62305.01	FIGURE 3-4
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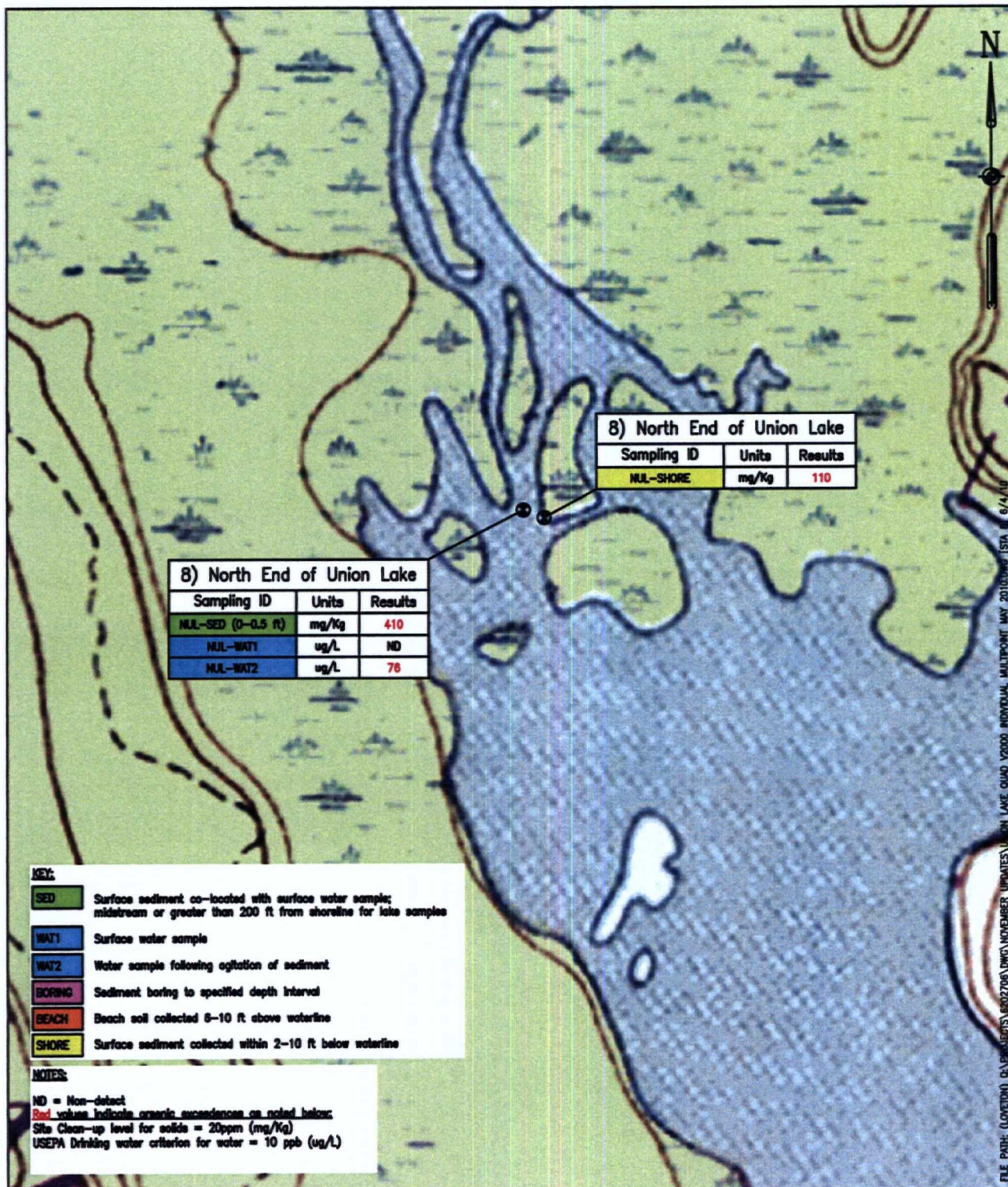


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PERIODIC SAMPLING—SPRING 2010
SAMPLE LOCATION
7) SHERMAN AVE.

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
—	—	MP	—	1"=500'	5-5-10	62305.01	3-5



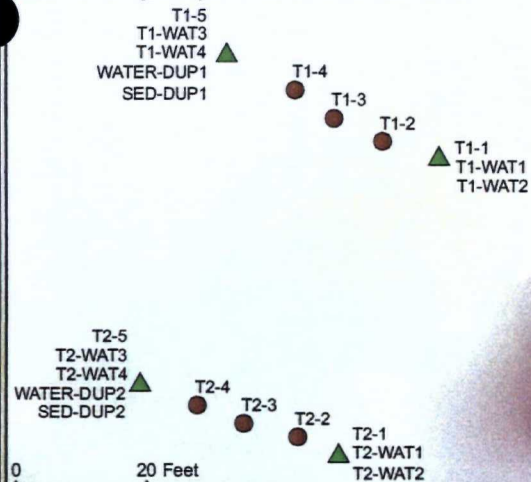
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VINELAND, NJ

PERIODIC SAMPLING—SPRING 2010
SAMPLE LOCATION
8) NORTH END OF UNION LAKE

PROJECT MGR —	DESIGNED BY —	DRAWN BY MP	CHECKED BY —	SCALE 1"=500'	DATE 5-5-10	PROJECT NO 62305.01	FIGURE 3-6
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Note: For clarity, sample IDs have been condensed



Alliance Beach

Alliance Beach Water Samples		
Sample ID	Units	Result
ALLIANCET1-WAT1	ug/L	ND
ALLIANCET1-WAT2	ug/L	15
ALLIANCET1-WAT3	ug/L	ND
ALLIANCET1-WAT4	ug/L	ND
ALLIANCET2-WAT1	ug/L	ND
ALLIANCET2-WAT2	ug/L	ND
ALLIANCET2-WAT3	ug/L	ND
ALLIANCET2-WAT4	ug/L	12
WATER-DUP1	ug/L	ND
WATER-DUP2	ug/L	8.3

Legend

- Sediment Arsenic Sample
- ▲ Sediment & Water Arsenic Sample

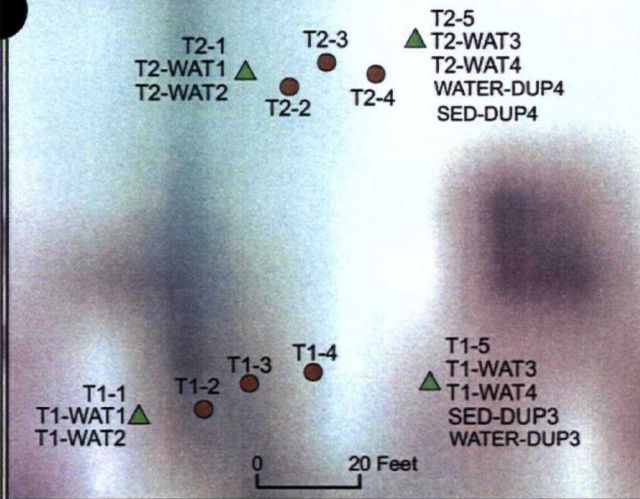
Alliance Beach Sediment Samples		
Sample ID	Units	Result
ALLIANCET1-1	mg/kg	0.87
ALLIANCET1-2	mg/kg	0.61
ALLIANCET1-3	mg/kg	ND
ALLIANCET1-4	mg/kg	ND
ALLIANCET1-5	mg/kg	ND
SED-DUP1	mg/kg	ND
ALLIANCET2-1	mg/kg	1.5
ALLIANCET2-2	mg/kg	2.1
ALLIANCET2-3	mg/kg	1.4
ALLIANCET2-4	mg/kg	1.4
ALLIANCET2-5	mg/kg	ND
SED-DUP2	mg/kg	0.55

Notes:

1. ND = non-detect
2. <value> = arsenic concentrations > 20 mg/kg for sediment samples (site clean-up level) and > 10 ug/L for water samples (USEPA drinking water criterion)

Note: For clarity, sample IDs have been condensed

Almond Beach



Almond Beach Water Samples		
Sample ID	Units	Result
ALMONDT1-WAT1	ug/L	ND
ALMONDT1-WAT2	ug/L	ND
ALMONDT1-WAT3	ug/L	ND
ALMONDT1-WAT4	ug/L	ND
WATER-DUP3	ug/L	ND
ALMONDT2-WAT1	ug/L	ND
ALMONDT2-WAT2	ug/L	ND
ALMONDT2-WAT3	ug/L	ND
ALMONDT2-WAT4	ug/L	ND
WATER-DUP4	ug/L	ND

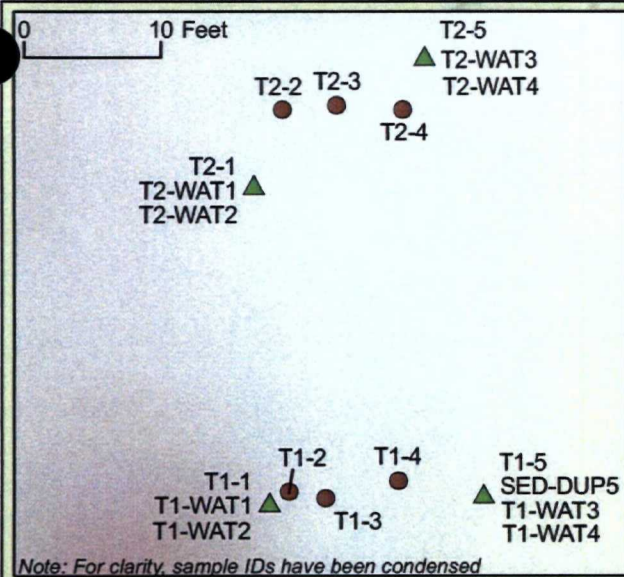
Almond Beach Sediment Samples		
Sample ID	Units	Result
ALMONDT1-1	mg/kg	0.89
ALMONDT1-2	mg/kg	1.3
ALMONDT1-3	mg/kg	0.66
ALMONDT1-4	mg/kg	0.66
ALMONDT1-5	mg/kg	ND
SED-DUP3	mg/kg	ND
ALMONDT2-1	mg/kg	0.72
ALMONDT2-2	mg/kg	1
ALMONDT2-3	mg/kg	1.4
ALMONDT2-4	mg/kg	5.3
ALMONDT2-5	mg/kg	1.5
SED-DUP4	mg/kg	1.1

Legend

- Sediment Arsenic Sample
- ▲ Sediment & Water Arsenic Sample

Notes:

1. ND = non-detect
2. <value> = arsenic concentrations > 20 mg/kg for sediment samples (site clean-up level) and > 10 ug/L for water samples (USEPA drinking water criterion)



"Bare A" Beach Water Samples		
Sample ID	Units	Result
BAT1-WAT1	ug/L	ND
BAT1-WAT2	ug/L	120
BAT1-WAT3	ug/L	ND
BAT1-WAT4	ug/L	29
BAT2-WAT1	ug/L	ND
BAT2-WAT2	ug/L	130
BAT2-WAT3	ug/L	ND
BAT2-WAT4	ug/L	150

"Bare A" Beach Sediment Samples		
Sample ID	Units	Result
BAT1-1	mg/kg	42
BAT1-2	mg/kg	450
BAT1-3	mg/kg	63
BAT1-4	mg/kg	32
BAT1-5	mg/kg	26
SED-DUP5	mg/kg	29
BAT2-1	mg/kg	320
BAT2-2	mg/kg	110
BAT2-3	mg/kg	5.3
BAT2-4	mg/kg	100
BAT2-5	mg/kg	2.6

Legend

- Sediment Arsenic Samples
- ▲ Sediment & Water Arsenic Samples

Notes:

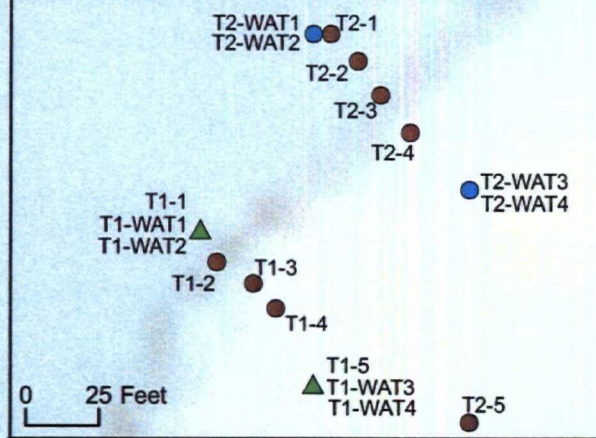
1. ND = non-detect
2. <value> = arsenic concentrations > 20 mg/kg for sediment samples (site clean-up level) and > 10 ug/L for water samples (USEPA drinking water criterion)

"Bare A" Beach

Figure 3-10. Beach Transect
Results at Station 6 ("BareA" Beach)

Union Lake Beach

Note: For clarity, sample IDs have been condensed



Union Lake Beach Water Samples		
Sample ID	Units	Result
ULBT1-WAT1	ug/L	ND
ULBT1-WAT2	ug/L	ND
ULBT1-WAT3	ug/L	ND
ULBT1-WAT4	ug/L	ND
ULBT2-WAT1	ug/L	ND
ULBT2-WAT2	ug/L	11
ULBT2-WAT3	ug/L	ND
ULBT2-WAT4	ug/L	ND

Union Lake Beach Sediment Samples		
Sample ID	Units	Result
ULBT1-1	mg/kg	7.7
ULBT1-2	mg/kg	7.2
ULBT1-3	mg/kg	4.5
ULBT1-4	mg/kg	2.2
ULBT1-5	mg/kg	1.4
ULBT2-1	mg/kg	4.8
ULBT2-2	mg/kg	5.8
ULBT2-3	mg/kg	2.8
ULBT2-4	mg/kg	2.2
ULBT2-5	mg/kg	1.5

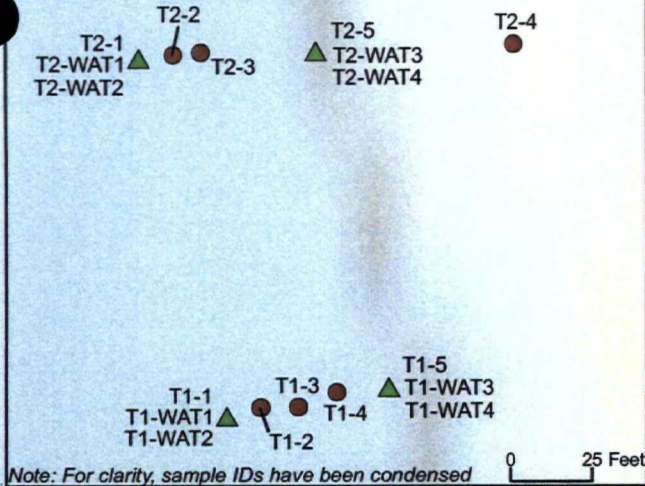
Legend

- Sediment Arsenic Sample
- Water Arsenic Sample
- ▲ Sediment & Water Arsenic Sample

Notes:

1. ND = non-detect
2. <value> = arsenic concentrations > 20 mg/kg for sediment samples (site clean-up level) and > 10 ug/L for water samples (USEPA drinking water criterion)

South Union Lake Beach



South Union Lake Beach Water Samples		
Sample ID	Units	Result
SULT1-WAT1	ug/L	ND
SULT1-WAT2	ug/L	ND
SULT1-WAT3	ug/L	ND
SULT1-WAT4	ug/L	ND
SULT2-WAT1	ug/L	ND
SULT2-WAT2	ug/L	ND
SULT2-WAT3	ug/L	ND
SULT2-WAT4	ug/L	11

South Union Lake Beach Sediment Samples		
Sample ID	Units	Result
SULT1-1	mg/kg	3
SULT1-2	mg/kg	1.4
SULT1-3	mg/kg	2.2
SULT1-4	mg/kg	ND
SULT1-5	mg/kg	ND
SULT2-1	mg/kg	1.7
SULT2-2	mg/kg	1.1
SULT2-3	mg/kg	1.9
SULT2-4	mg/kg	2.4
SULT2-5	mg/kg	ND

Legend

- Sediment Arsenic Samples
- ▲ Sediment & Water Arsenic Samples

Notes:

1. ND = non-detect
2. <value> = arsenic concentrations > 20 mg/kg for sediment samples (site clean-up level) and > 10 ug/L for water samples (USEPA drinking water criterion)

**TABLE 3-1. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED IN VICINITY OF
VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010
VINELAND PERIODIC SAMPLING - SPRING 2010**

Sample Location	Station ID	Units	Average RL	Result
1) West of Mill Rd	-	-	-	-
2) West of Rte 55	-	-	-	-
3) BWB & Maurice Confluence	BWB-WAT1	ug/L	8	U
	BWB-WAT2	ug/L		
4) Alliance Beach	ALLIANCE-WAT1	ug/L	8	U
	ALLIANCE-WAT2	ug/L	8	U
5) Almond Beach	ALMOND-WAT1	ug/L	8	U
	ALMOND-WAT2	ug/L	8	U
6) "BareA" Beach	BA-WAT1	ug/L		8.9
	BA-WAT2	ug/L		
7) Sherman Ave.	SHERMAN-WAT1	ug/L	8	U
	SHERMAN-WAT2	ug/L	8	U
8) North End of Union Lake	NUL-WAT1	ug/L	8	U
	NUL-WAT2	ug/L		
9) Union Lake Beach	ULB-WAT1	ug/L		
	ULB-WAT2	ug/L		
10) South End Union Lake Beach	SUL-WAT1	ug/L	8	U
	SUL-WAT2	ug/L		
Duplicates	DUP-4 (BA-WAT2)	ug/L		
	DUP-5 (ALMOND-WAT2)*	ug/L	8	U
Equipment Blank	PBlank-01	ug/L	8	U
	PBlank-02	ug/L	8	U
	PBlank-03	ug/L	8	U
	TTBlank-01	ug/L	8	U

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values exceed the USEPA Drinking Water Criterion of 10 ug/L (ppb)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

**TABLE 3-2. ARSENIC CONCENTRATIONS (mg/Kg) IN SOIL AND SEDIMENT SAMPLES COLLECTED IN
VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010
VINELAND PERIODIC SAMPLING - SPRING 2010**

Sample Location	Station ID	Units	Matrix	Average RL	Result
1) West of Mill Rd	-	-	-	-	-
2) West of Rte 55	-	-	-	-	-
3) BWB & Maurice Confluence	BWB-SED	mg/Kg	Sediment		3.1
	BWB-SHORE	mg/Kg	Sediment		
4) Alliance Beach	ALLIANCE-BEACH	mg/Kg	Soil		0.67
	ALLIANCE-SED	mg/Kg	Sediment		2
	ALLIANCE-SHORE	mg/Kg	Sediment		0.84
5) Almond Beach	ALMOND-BEACH	mg/Kg	Soil	0.54	U
	ALMOND-SED	mg/Kg	Sediment		1.2
	ALMOND-SHORE	mg/Kg	Sediment	0.46	U
6) "BareA" Beach	BA-BEACH	mg/Kg	Soil	0.57	U
	BA-SED	mg/Kg	Sediment		
	BA-SHORE	mg/Kg	Sediment		
7) Sherman Ave.	SHERMAN-SED	mg/Kg	Sediment		3.8
	SHERMAN-SHORE	mg/Kg	Sediment		3.7
8) North End of Union Lake	NUL-SED	mg/Kg	Sediment		
	NUL-SHORE	mg/Kg	Sediment		
9) Union Lake Beach	ULB-BEACH	mg/Kg	Soil		1.1
	ULB-SED	mg/Kg	Sediment		
	ULB-SHORE	mg/Kg	Sediment		2.3
10) South End Union Lake Beach	SUL-BEACH	mg/Kg	Soil		0.53
	SUL-SED	mg/Kg	Sediment		9.8
	SUL-SHORE	mg/Kg	Sediment		1.2
Duplicate	DUP-1 (ALMOND-SHORE)	mg/Kg	Sediment	0.48	U
	DUP-2 (ALMOND-SED)	mg/Kg	Sediment		1
	DUP-3 (SUL-BEACH)	mg/Kg	Soil	0.58	U

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values are equivalent to or exceed the Site Clean-up Level of 20 mg/Kg (ppm)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

**TABLE 3-3. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED AT
ADDITIONAL BEACH TRANSECTS
VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010**

Sample Location	Sample ID	Units	Average RL	Result
4) Alliance Beach	ALLIANCET1-WAT1	ug/L	8	ND
	ALLIANCET1-WAT2	ug/L		
	ALLIANCET1-WAT3	ug/L	8	ND
	ALLIANCET1-WAT4	ug/L	8	ND
	ALLIANCET2-WAT1	ug/L	8	ND
	ALLIANCET2-WAT2	ug/L	8	ND
	ALLIANCET2-WAT3	ug/L	8	ND
	ALLIANCET2-WAT4	ug/L		
5) Almond Beach	ALMONDT1-WAT1	ug/L	8	ND
	ALMONDT1-WAT2	ug/L	8	ND
	ALMONDT1-WAT3	ug/L	8	ND
	ALMONDT1-WAT4	ug/L	8	ND
	ALMONDT2-WAT1	ug/L	8	ND
	ALMONDT2-WAT2	ug/L	8	ND
	ALMONDT2-WAT3	ug/L	8	ND
	ALMONDT2-WAT4	ug/L	8	ND
6) "Bare A" Beach	BAT1-WAT1	ug/L	8	ND
	BAT1-WAT2	ug/L		
	BAT1-WAT3	ug/L	8	ND
	BAT1-WAT4	ug/L		
	BAT2-WAT1	ug/L	8	ND
	BAT2-WAT2	ug/L		
	BAT2-WAT3	ug/L	8	ND
	BAT2-WAT4	ug/L		
9) Union Lake Beach	ULBT1-WAT1	ug/L	8	ND
	ULBT1-WAT2	ug/L	8	ND
	ULBT1-WAT3	ug/L	8	ND
	ULBT1-WAT4	ug/L	8	ND
	ULBT2-WAT1	ug/L	8	ND
	ULBT2-WAT2	ug/L		
	ULBT2-WAT3	ug/L	8	ND
	ULBT2-WAT4	ug/L	8	ND
10) South End Union Lake Beach	SULT1-WAT1	ug/L	8	ND
	SULT1-WAT2	ug/L	8	ND
	SULT1-WAT3	ug/L	8	ND
	SULT1-WAT4	ug/L	8	ND
	SULT2-WAT1	ug/L	8	ND
	SULT2-WAT2	ug/L	8	ND
	SULT2-WAT3	ug/L	8	ND
	SULT2-WAT4	ug/L		
Duplicates	WATER-DUP1 (ALLIANCET1-WAT4)	ug/L	8	ND
	WATER-DUP2 (ALLIANCET2-WAT4)	ug/L		8.3
	WATER-DUP3 (ALMONDT1-WAT4)	ug/L	8	ND
	WATER-DUP4 (ALMONDT2-WAT4)	ug/L	8	ND

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values exceed the USEPA Drinking Water Criterion of 10 ug/L (ppb)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

**TABLE 3-4. ARSENIC CONCENTRATIONS (mg/Kg) IN SEDIMENT SAMPLES
COLLECTED AT ADDITIONAL BEACH TRANSECTS
VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010**

Sample Location	Sample ID	Units	Average RL	Result
4) Alliance Beach	ALLIANCET1-1	mg/kg		0.87
	ALLIANCET1-2	mg/kg		0.61
	ALLIANCET1-3	mg/kg	0.47	ND
	ALLIANCET1-4	mg/kg	0.47	ND
	ALLIANCET1-5	mg/kg	0.48	ND
	ALLIANCET2-1	mg/kg		1.5
	ALLIANCET2-2	mg/kg		2.1
	ALLIANCET2-3	mg/kg		1.4
	ALLIANCET2-4	mg/kg		1.4
	ALLIANCET2-5	mg/kg	0.51	ND
5) Almond Beach	ALMONDT1-1	mg/kg		0.89
	ALMONDT1-2	mg/kg		1.3
	ALMONDT1-3	mg/kg		0.66
	ALMONDT1-4	mg/kg		0.66
	ALMONDT1-5	mg/kg	0.49	ND
	ALMONDT2-1	mg/kg		0.72
	ALMONDT2-2	mg/kg		1
	ALMONDT2-3	mg/kg		1.4
	ALMONDT2-4	mg/kg		5.3
	ALMONDT2-5	mg/kg		1.5
6) "Bare A" Beach	BAT1-1	mg/kg		
	BAT1-2	mg/kg		
	BAT1-3	mg/kg		
	BAT1-4	mg/kg		
	BAT1-5	mg/kg		
	BAT2-1	mg/kg		
	BAT2-2	mg/kg		
	BAT2-3	mg/kg		5.3
	BAT2-4	mg/kg		
	BAT2-5	mg/kg		2.6
9) Union Lake Beach	ULBT1-1	mg/kg		7.7
	ULBT1-2	mg/kg		7.2
	ULBT1-3	mg/kg		4.5
	ULBT1-4	mg/kg		2.2
	ULBT1-5	mg/kg		1.4
	ULBT2-1	mg/kg		4.8
	ULBT2-2	mg/kg		5.8
	ULBT2-3	mg/kg		2.8
	ULBT2-4	mg/kg		2.2
	ULBT2-5	mg/kg		1.5
10) South End Union Lake Beach	SULT1-1	mg/kg		3
	SULT1-2	mg/kg		1.4
	SULT1-3	mg/kg		2.2
	SULT1-4	mg/kg	0.53	ND
	SULT1-5	mg/kg	0.51	ND
	SULT2-1	mg/kg		1.7
	SULT2-2	mg/kg		1.1
	SULT2-3	mg/kg		1.9
	SULT2-4	mg/kg		2.4
	SULT2-5	mg/kg	0.56	ND
Duplicates	SED-DUP1 (ALLIANCET1-5)	mg/kg	0.48	ND
	SED-DUP2 (ALLIANCET2-5)	mg/kg		0.55
	SED-DUP3 (ALMONDT1-5)	mg/kg	0.45	ND
	SED-DUP4 (ALMONDT2-5)	mg/kg		1.1
	SED-DUP5 (BAT1-5)	mg/kg		

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values are equivalent to or exceed the Site Clean-up Level of 20 mg/Kg (ppm)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

4. SUMMARY AND COMPARISONS OF PERIODIC SAMPLING – SPRING 2010 TO PREVIOUS DATA

Overall, results of the Periodic Sampling – Spring 2010 indicated one more exceedance of the arsenic criterion for agitated water samples than for the previous sampling event (Periodic Sampling – Fall 2009). Arsenic concentrations in agitated water samples exceeded the 10 µg/L criterion at five of the eight sampling locations. The last sampling event, Periodic Sampling – Fall 2009, had exceedances in agitated water samples at four of eight locations. The highest concentration of arsenic in an agitated water sample for Spring 2010 was at Station 6 (“Bare A” Beach) with a value of 370 µg/L.

As was noted in Section 1.4, Station 1 (West of Mill Road) and Station 2 (West of Route 55) were not sampled due to remediation activities and stream realignment at these locations. Stations located downstream from Station 2 and upstream of Station 6 (“Bare A” Beach) did not have arsenic concentrations in sediment samples that exceeded the Site Clean-up criterion of 20 ppm. Sediment samples at Station 6, Station 8 (North End of Union Lake), and Station 9 (Union Lake Beach) had arsenic concentrations in sediment samples that exceeded 20 ppm. Arsenic concentrations ranged from 120 mg/Kg at Station 6 to 410 mg/Kg at Station 8. Station 10 (South End of Union Lake) had a detected arsenic concentration of 9.8 mg/Kg but did not exceed the Site Clean-up criterion.

Three of eight locations had arsenic concentrations in shore samples that exceeded the Site Clean-up criterion of 20 ppm. Station 3 (Blackwater Branch confluence) had a concentration of 150 mg/Kg, Station 6 (“Bare A” Beach) had a concentration of 160 mg/Kg, and Station 8 (North End of Union Lake) had a concentration of 110 mg/Kg. The same three stations had exceedances in the Fall 2009 sampling effort. Station 6 had a decrease of arsenic from 280 mg/Kg in Fall 2009 to 160 mg/Kg in Spring 2010. Stations 3 and 8 had increases of arsenic concentrations between Fall 2009 and Spring 2010. Station 3 arsenic concentration increased from 21 mg/Kg in Fall 2009 to 150 mg/Kg in Spring 2010 and Station 8 had an increase from 65 mg/Kg in Fall 2009 to 110 mg/Kg in Spring 2010.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 Sampling events, arsenic concentrations in sediments, water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 (“BareA” Beach). In September 2007, the first exceedance of applicable criteria occurred at Station 5 (Almond Beach) in the agitated water sample and at Station 6 (“BareA” Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009, the only samples to exceed the Site Clean-up Levels and USEPA Drinking Water Criterion south of Station 2 (West of Route 55) and north of Union Lake were the agitated water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/Kg, respectively. Sampling in November 2009 had three exceedances of criteria; the agitated water sample (Wat2) at Station 7 (Sherman Avenue) and the shore samples at Station 4 and Station 6. For the Periodic Sampling – Spring 2010, five exceedances of arsenic criterion occurred between Station 2 and the north end of Union Lake. Agitated water samples at Station 3 (Blackwater Branch confluence) and Station 6

had arsenic concentrations of 58 µg/L and 370 µg/L, respectively. The sediment sample at Station 6 exceeded the Site Clean-up Level of 20 ppm with an arsenic concentration of 120 mg/Kg. Shore sediment samples at Station 3 and Station 6 also exceeded 20 ppm; Station 3 had an arsenic concentration of 150 mg/Kg and Station 6 had an arsenic concentration of 160 mg/Kg.

Agiated water samples, sediment, and shore samples in the Union Lake area had exceedances of their respective criterion. Agiated water samples at Station 8 (North End of Union Lake), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake) had arsenic concentrations of 76 µg/L, 120 µg/L, and 14 µg/L, respectively; the three locations exceeded the criterion of 10 µg/L. Sediment samples at Stations 8 and 9 exceeded the Site Clean-up Level of 10 ppm; Station 8 had an arsenic concentration of 410 mg/Kg and Station 9 had an arsenic concentration of 330 mg/Kg. Station 8 was the only location to exceed 10 ppm for shore samples with an arsenic concentration of 110 mg/Kg.

The frequency of arsenic detection and percentage of samples exceeding applicable criteria for the past six sampling events is listed below:

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	57	32
November 2006	53	27
September 2007	68	42
May 2009	49	23
November 2009	54	24
April/May 2010	67	30

The frequency of detection and frequency of exceeding applicable criteria that were observed in May 2006 (Baseline Sampling) and November 2006 (Periodic Sampling) showed a trend towards decreasing arsenic in the samples. The increased frequency of detection and frequency of exceeding applicable criteria that were observed in the September 2007 Post Remedial Action Sampling could potentially be attributed to the excavation activities associated with the remedial actions currently that were started between Mill Road and Route 55. Periodic Sampling in November 2009 and April/May 2010 had been completed while remedial actions were ongoing from Mill Road to the confluence of the Blackwater Branch with the Maurice River. The remedial activities may be associated with the trend of increased frequency of arsenic detection in samples and samples exceeding the Site Clean-up Level and USEPA Drinking Water Criterion.

4.1 Summary of Periodic Sampling – Spring 2010 Arsenic Results by Station

Station 1 – West of Mill Rd (see Figure 3-1)

Station 1 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 2 – West of Rte 55 (see Figure 3-1)

Station 2 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)

Arsenic was detected above the USEPA Drinking Water Criterion of 10 ppb in the agitated water sample at a concentration of 58 µg/L. The shore sediment sample was detected at a concentration of 150 mg/Kg, 7.5 times above the Site Clean-up Level of 20 ppm. Arsenic was detected in the surficial mid-stream sediment sample at 3.1 mg/Kg.

Station 4 – Alliance Beach (see Figures 3-1, 3-2, and 3-8)

Arsenic was detected in the surficial mid-stream sediment sample at 2.0 mg/Kg and in the shore sediment sample at 0.84 mg/Kg. Arsenic was not detected in the water samples. In the additional beach transects, none of the arsenic concentrations exceeded the Site Clean-up Level. Two of the agitated water samples exceeded the USEPA Drinking Water Criterion.

Station 5 – Almond Beach (see Figures 3-1, 3-3, and 3-9)

Arsenic was not detected in the water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 1.2 mg/Kg. In the additional beach transects, arsenic was not detected in the sediment samples; arsenic detected in the water samples was below USEPA Drinking Water Criterion.

Station 6 – “BareA” Beach (see Figures 3-1, 3-4, and 3-10)

Arsenic was detected in the pre-agitated water sample (8.9 µg/L) and agitated water sample (370 µg/L); the agitated water sample exceeded the USEPA Drinking Water Criterion of 10 ppb by a factor of 37. The sediment sample exceeded the Site-Clean up Level of 20 ppm by a factor of 6 with an arsenic concentration of 120 mg/Kg. The shore sample had an arsenic concentration of 160 mg/Kg exceeding the 20 ppm criterion by a factor of 8. Arsenic was not detected in the beach sample. The additional beach transect results had 8 of 10 sediment samples exceeding the Site Clean-up Level. Four water samples at the additional beach transects exceeded the USEPA Drinking Water Criterion; the four samples were agitated water samples.

Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)

Arsenic was not detected in the water sample. Arsenic was detected in the sediment sample (3.8 mg/Kg) and shore sample (3.7 mg/Kg); both were below the Site Clean-up Level of 20 ppm.

Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)

The agitated water sample exceeded the criterion of 10 ppb by a factor of 7.6 with an arsenic concentration of 76 µg/L. Arsenic was detected in both the sediment sample (410 mg/Kg) and shore sample (110 mg/Kg). The samples exceeded the Site Clean-up Level of 20 ppm by factors of 20.5 and 5.5, respectively.

Station 9 – Union Lake Beach (see Figures 3-1, 3-7, and 3-11)

The pre-agitated water sampled exceeded the criterion of 10 ppb by a factor of 1.4 with a concentration of 14 µg/L. The agitated water sample also exceeded the criterion of 10 ppb by a factor of 12 with an arsenic concentration of 120 µg/L. Arsenic was detected in the sediment

sample at a concentration of 330 mg/Kg exceeding the 20 ppm criterion by a factor of 16.5. Arsenic was detected below the 20 ppm criterion in the shore sample with a concentration of 2.3 mg/kg and in the beach sample with a concentration of 1.1 mg/Kg. In additional beach transects, arsenic was detected in all of the sediment samples but at concentrations lower than the Site Clean-up Level of 10 ppm. One agitated water sample, ULBT2-WAT2, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

Station 10 – South End of Union Lake Beach (see Figures 3-1, 3-7 and 3-12)

Arsenic was detected in the agitated water sample at a concentration of 14 ug/L; this exceeded the Drinking Water Criteria by a factor of 1.4. The sediment sample had an arsenic concentration of 9.8 mg/Kg and in the shore sample at a concentration of 1 mg/Kg; both samples were below the Site Clean-up Level of 20 ppm. Arsenic was not detected in the beach sample at this location. In additional beach transects, arsenic detected in sediment samples was below the criterion of 20 ppm. One agitated water sample, SULT2-WAT4, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

4.2 Comparison of April 2010 Arsenic Results to November 2009, May 2009, September 2007, November 2006, and May 2006 Arsenic Results

The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain from Mill Road to the Maurice River Parkway (west of Route 55). The baseline sampling conducted in May 2006 and the November 2006 Periodic Sampling was conducted during the excavation/construction activities. Sampling in September 2007 occurred during remediation of the Blackwater Branch and floodplain east of Mill Road and adjacent to the Vineland Chemical Superfund site. Sampling in May 2009 occurred during remediation of the Blackwater Branch west of Mill Road to Route 55. During sampling in November 2009, remediation activities had extended from west of Mill Road to west of Route 55 down to the Maurice River Parkway. The results from the previous sampling events are compared to the results from the Periodic Sampling – Spring 2010 (April 2010).

In the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, and the September 2007 Post Remedial Action Sampling, arsenic concentrations were analyzed in sediments, soil, and water collected at the same ten locations in and near waterways located adjacent to the site. Both the May 2006 Baseline Sampling and the September 2007 Post Remedial Action Sampling included the collection and analysis of deep sediment cores; the November 2006 Periodic Sampling effort did not include the collection and analysis of deep sediment cores. With the exception of core sampling and analysis and the exclusion of Station 1 (West of Mill Road) and Station 2 (West of Route 55), the sampling scheme and sampling locations for the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 were identical. The following paragraphs and Table 4-1 compare the results of the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 for sediment, soil, and water samples.

May and November 2006, September 2007, May and November 2009, and April/May 2010
Arsenic Surface Water Data

The May 2006 results indicated that five of 20 surface water samples exceeded the applicable criteria, the November 2006 results indicated that only three of 20 surface water samples exceeded the applicable criterion, and the September 2007 results indicated that ten of 20 surface water samples exceeded the applicable criterion. Results of the May 2009 sampling showed that three of 18 surface water samples exceeded the USEPA Drinking Water Criterion of 10 µg/L. November 2009 results showed that four of 16 samples exceeded the USEPA Drinking Water Criterion. Four of the 10 surface water samples exceeded the Drinking Water Criterion in the April 2010 sampling. Surface water arsenic concentrations that were equivalent to or exceeded the USEPA Drinking Water Criterion of 10 µg/L ranged from 10 to 1,900 µg/L for the May 2006 sampling, from 11 to 900 µg/L for the November 2006 sampling, from 12 to 3,800 µg/L for the September 2007 sampling, and from 65 to 12,000 µg/L for the May 2009 sampling. In November 2009, the concentrations that were equivalent to or exceeded the 10 µg/L criterion ranged from 19 to 1,100 µg/L. Water samples that exceeded the criterion in April/May 2010 ranged from 14 to 370 µg/L.

Data for each of the six sampling events indicated that the stations with the highest arsenic concentrations were located directly downstream of the site – Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55). Generally, for the November 2006 Periodic Sampling and May 2009 sampling, only the agitated water samples (versus pre-agitated water samples) exceeded the USEPA Drinking Water Criterion of 10 µg/L (ppb). In September 2007, there were substantially more exceedences of arsenic in the agitated water samples at the majority of the stations. First-time exceedences of the USEPA Drinking Water Criterion for arsenic in surface water occurred at Station 5 (Almond Beach), Station 8 (North End of Union Lake), and Station 9 (Union Lake Beach) in September 2007. In May 2009 and November 2009, only agitated water sampled exceeded the USEPA Drinking Water Criterion. In April/May 2010, five of eight agitated water samples exceeded the USEPA Drinking Water Criterion. At Station 9, the pre-agitated water sample exceeded the criterion with an arsenic concentration of 14 µg/L.

May and November 2006, September 2007, May and November 2009, and April/May 2010
Arsenic Mid-Stream Sediment (0-0.5ft) Data

The May 2006 results indicated that four of 10 sediment samples exceeded the applicable criterion of 20 ppm, the November 2006 results indicated that five of 10 sediment samples exceeded the applicable criterion, and the September 2007 results indicated that four of 10 sediment samples exceeded the applicable criterion. In May 2009, four of 9 sediment samples exceeded the applicable criterion. Two of eight samples exceeded the applicable criterion in November 2009. Samples collected in April/May 2010 had three of 8 samples that exceeded the applicable criterion.

Arsenic concentrations that exceeded the Site Clean-up Level of 20 ppm ranged from 160 to 1,500 mg/Kg for the May 2006 results, from 20 to 2,100 mg/Kg for the November 2006 results, from 30 to 1,700 mg/Kg for the September 2007 results, and from 28 to 340 mg/Kg for the May 2009 results. The arsenic concentrations that exceeded the applicable criterion in November 2009 were 330 mg/Kg at Station 9 (Union Lake Beach) and 40 mg/Kg at Station 10 (South End of Union Lake). For the April/May 2010 sampling effort, Station 6 (“Bare A” Beach) had an

arsenic concentration of 120 mg/Kg, Station 8 (North End of Union Lake) had a concentration of 410 mg/Kg, and Station 9 had an arsenic concentration of 330 mg/Kg.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Nearshore (Shore) Sediment (0-0.5ft) Data

Shore stations from Station 1 (West of Mill Rd.), Station 2 (West of Rte. 55), and Station 8 (North End of Union Lake) exceeded the Site Clean-up Level of 20 ppm for the May 2006, November 2006, and September 2007 sampling events. For the May 2009 sampling, Station 2 and Station 8 exceeded the applicable criterion. In September 2007 and May 2009, the shore sample for Station 6 ("BareA" Beach) also exceeded the criterion. Results from the November 2009 sampling show that Station 3 (Blackwater Branch confluence), Station 6 ("BareA" Beach), and Station 8 (North End of Union Lake) exceeded the criterion. In April/May 2010 three of eight locations had shore samples that exceeded the criterion; Station 3 (Blackwater Branch confluence), Station 6, and Station 8 (North End of Union Lake).

Arsenic concentrations in the shore sediments that exceeded the Site Clean-up Level of 20 mg/Kg (ppm) ranged from 88 to 1,200 mg/Kg, 140 to 4,500 mg/Kg, and 110 to 3,400 mg/Kg for the May 2006, November 2006, and September 2007 events, respectively. The range for May 2009 was 21 to 2,100 mg/Kg and the range for November 2009 was 21 to 280 mg/Kg. April/May 2010 arsenic shore concentrations that exceeded the criterion ranged from 110 to 160 mg/Kg.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Beach Soil (0-0.5ft) Data

Detected concentrations between May 2006 and April/May 2010 were either comparable to or lower than those previously reported for each of the five beach stations. None of the 2006, 2007, 2009, and 2010 beach samples exceeded the Site Clean-up Level of 20 mg/kg for arsenic in soil.

4.3 Comparison of Periodic Sampling – Spring 2010 Arsenic Results to Historical Data

During 1992 and from 1994 through 1999, water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). These data were collected to evaluate the results against human health risk-based action levels and were part of an annual monitoring program performed at beaches along the Maurice River and Union Lake (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). Each of the matrices (water, soil, and sediment) was not collected at each station every year. From 1992 and 1994 through 1999, no discernable trends in the historical arsenic data were evident; the concentration of arsenic in each matrix appeared to remain relatively constant over time (USEPA/ERTC 1999). The 1999 report that contains historical arsenic data for the 1992 and 1994 through 1999 is provided in Appendix D. These data were compared to data from the 2006, 2007, 2009, and 2010 sampling events.

The historical arsenic data for the five stations (listed above) were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial

Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 for surface water, beach soils, and surficial sediment arsenic concentrations (Tables 4-2 through 4-4 and Figures 4-1 through 4-3, respectively). The following paragraphs compare the historical arsenic data (1992 and 1994 through 1999) to the data collected in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 by matrix (water, soil, and sediment) and by station. Five of the ten total stations that were sampled in the May and November 2006, September 2007, May 2009, November 2009, and April 2010 sampling surveys were also sampled in 1992 and 1994 through 1999; the five stations included in the 2006, 2007, 2009, and 2010 surveys that were not previously sampled (Stations 1, 2, 3, 7, and 8) are not included in this discussion.

Comparisons to Historical Arsenic Surface Water Data (1992, 1994 through 1999, 2006, 2007, 2009, and 2010)

Throughout the period of 1992 and 1994-1999, arsenic concentrations in surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 ppb. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Surface water data from samples collected in both May 2006 and November 2006 indicated that arsenic was not detected in the surface waters at each of these five previously sampled locations (Stations 4, 5, 6, 9, and 10), with the exception of Station 10 (South End of Union Lake Beach) in May 2006, when arsenic in the agitated water sample was equivalent to the USEPA Drinking Criterion. However, in September 2007, there were several exceedences of the arsenic criterion in surface water. The majority of these exceedences corresponded to agitated water samples. During the May 2009 sampling only two agitated samples exceeded the arsenic criterion. The exceedences were found at Station 6 and Station 10. November 2009 sampling resulted in two agitated water samples that exceeded the arsenic criterion; Station 9 had an arsenic concentration of 1,100 µg/L and Station 10 had a concentration of 19 µg/L. Samples collected in April 2010 had four exceedences of the Drinking Water Criterion. One of the exceedences was at Station 9 in the pre-agitated sample (14 µg/L). The remaining three exceedences were in agitated samples at Stations 6, 9, and 10. The November 2009 arsenic concentration of 1,100 µg/L at Station 9 was the highest concentration measured between 1992 and 2010. Table 4-2 and Figure 4-1 show the comparisons of data results from 1992 to November 2009.

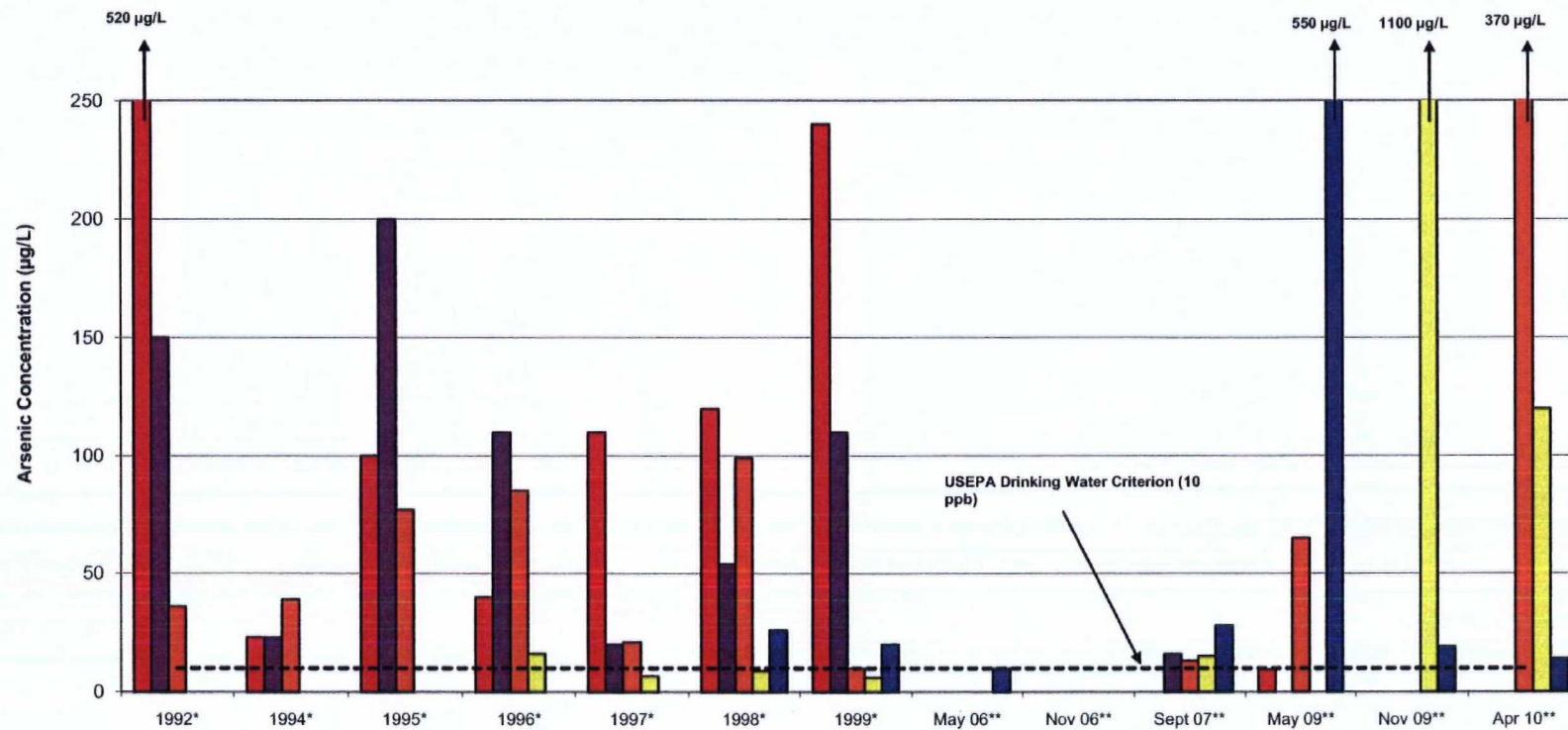
Comparisons to Historical Beach Soil Data (1992, 1994 through 1999, 2006, 2007, and 2010)

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, 2009, and 2010 samples exceeded the Site Clean-up Level of 20 ppm. Table 4-3 and Figure 4-2 present the comparisons of beach soil data results from 1992 to November 2009.

Comparisons to Historical Surface Sediment Data (1992, 1994 through 1999, 2006, 2007, 2009, and 2010)

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in arsenic concentration at Station 9 and Station 10 compared to May 2009 results. Surface sediment collected in April 2010 showed an increase in arsenic concentrations at Station 6 ("Bare A" Beach) compared to November 2009 results. Arsenic concentrations in surficial sediment at Station 9 were equivalent to results in November 2009. Table 4-4 and Figure 4-3 show the comparisons of surficial sediment data results from 1992 to November 2009.

Figure 4-1. Arsenic Concentrations (µg/L) in Water Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2010



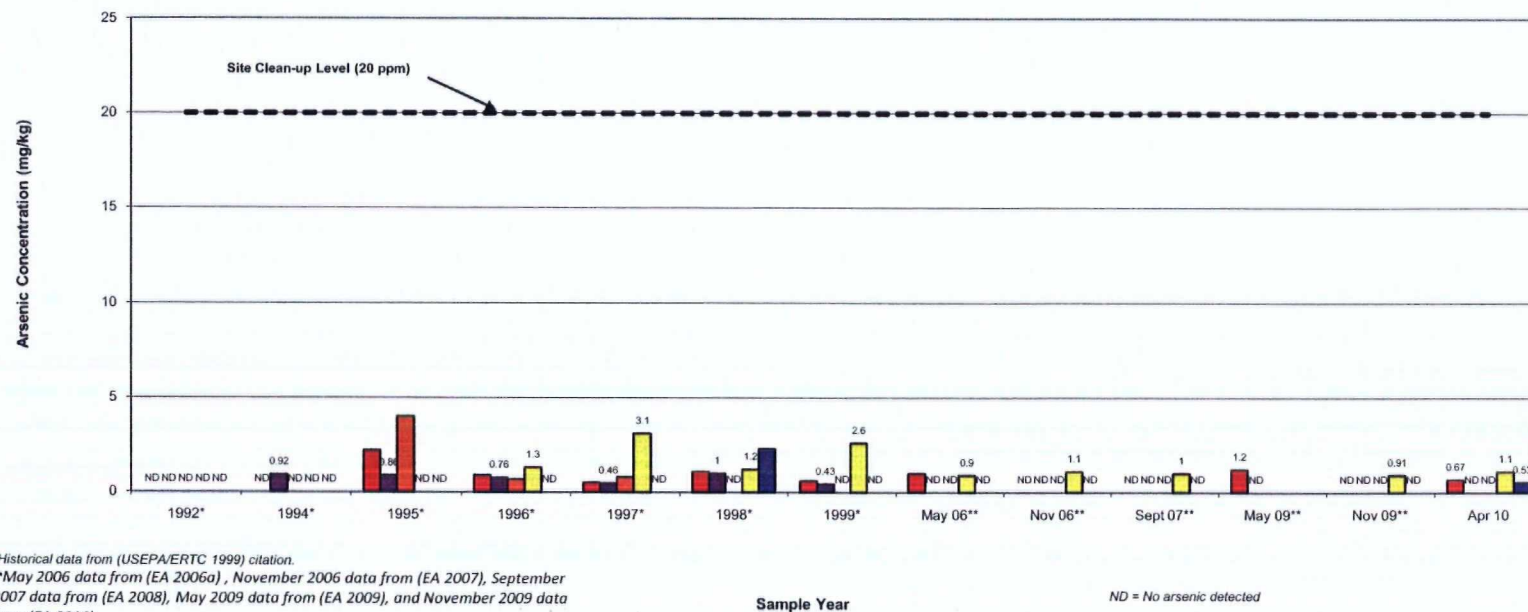
*Historical data from (USEPA/ERTC 1999) citation.

Sample Year

**Maximum water value presented on graph. Not all 2006/07/09/10 sampling stations included in this figure. May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010). Values represent agitated water samples.

4) Alliance Beach 5) Almond Beach 6) "Bare A" Beach 9) Union Lake Beach 10) South End Union Lake Beach --- USEPA Drinking Water Criterion (ppb)

Figure 4-2. Arsenic Concentrations (mg/Kg) in Beach (Soil) Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2010



*Historical data from (USEPA/ERTC 1999) citation.

**May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010).

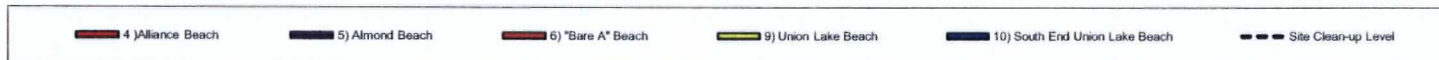
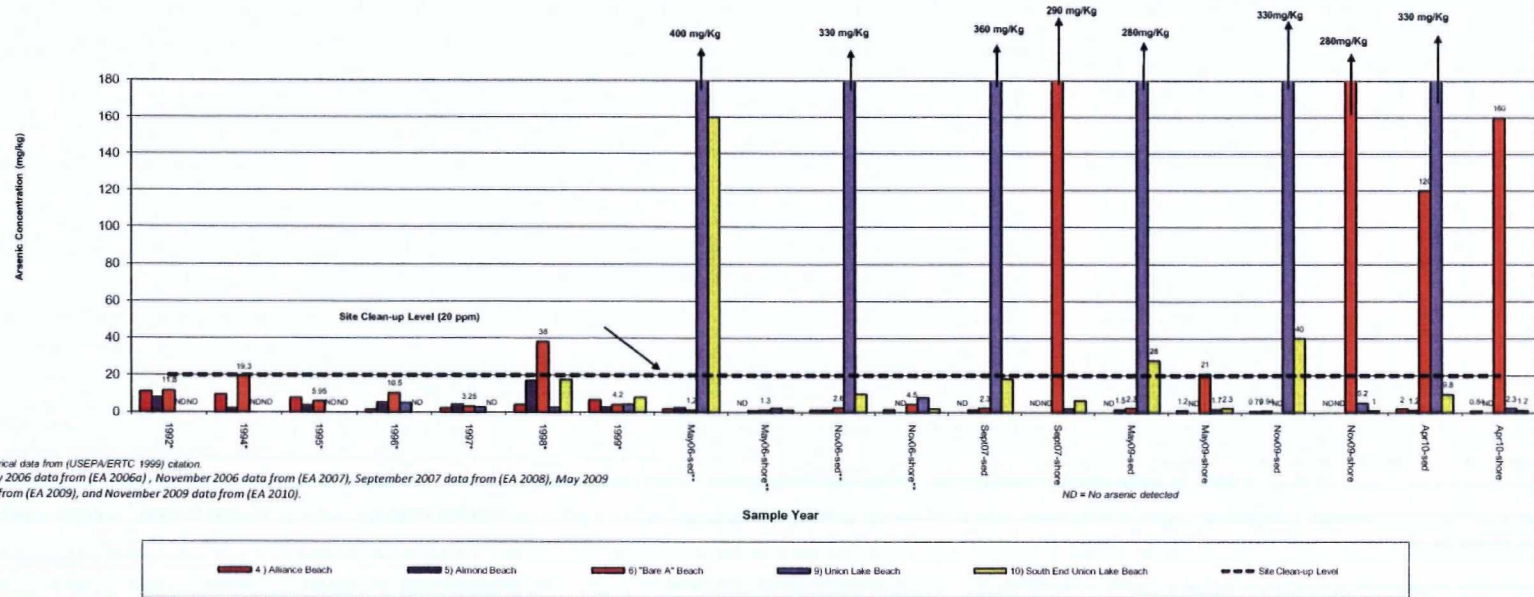


Figure 4-3. Arsenic Concentrations (mg/Kg) in Surficial Sediment Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2010



*Historical data from (USEPA/ERTC 1999) citation.

**May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010).

**TABLE 4-1. COMPARISON OF ARSENIC RESULTS FOR SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL
SUPERFUND SITE BETWEEN MAY 2006 AND SPRING 2010**
VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Station	Units	May 2006 Baseline Sampling	November 2006 Periodic Sampling	September 2007 Post Remedial Action Sampling	Periodic Sampling - Spring 2009 (May)	Periodic Sampling - Fall 2009 (November)	Periodic Sampling - Spring 2010 (April and May)
Water Sample Results							
1) MILL-WAT1	µg/L		U	U	-	-	-
1) MILL-WAT2	µg/L	U			-	-	-
2) R55-WAT1	µg/L		8.8		U	-	-
2) R55-WAT2	µg/L					-	-
3) BWB-WAT1	µg/L	U	U	U	U	U	U
3) BWB-WAT2	µg/L	U	U	U	U	U	
4) ALLIANCE-WAT1	µg/L	U	U	U	U	U	U
4) ALLIANCE-WAT2	µg/L	U	U	U	9.4	U	U
5) ALMOND-WAT1	µg/L	U	U	U	U	U	U
5) ALMOND-WAT2	µg/L	U	U		U	U	U
6) BA-WAT1	µg/L	U	U		U	U	8.9
6) BA-WAT2	µg/L	U	U	U		U	
7) SHERMAN-WAT1	µg/L	U	U		U	U	U
7) SHERMAN-WAT2	µg/L				U		U
8) NUL-WAT1	µg/L	U	U	U	U	U	U
8) NUL-WAT2	µg/L	U	U		U		
9) ULB-WAT1	µg/L	U	U	U	U	10	14
9) ULB-WAT2	µg/L	U	U		U		
10) SUL-WAT1	µg/L	U	U	U	U	9.2	U
10) SUL-WAT2	µg/L		U				
Sediment Results							
1) MILL-SED	mg/Kg	14		8.2	-	-	-
2) R55-SED	mg/Kg				-	-	-
3) BWB-SED	mg/Kg	0.78		1.5	1.2	1.1	3.1
4) ALLIANCE-SED	mg/Kg	1.9	1.3	U	U	0.79	2
5) ALMOND-SED	mg/Kg	2.5	1.4	1.3	1.5	0.94	1.2
6) BA-SED	mg/Kg	1.2	2.6	2.3	2.3	U	
7) SHERMAN-SED	mg/Kg	12	7.3		3.3	1.8	3.8
8) NUL-SED	mg/Kg					14	
9) ULB-SED	mg/Kg						
10) SUL-SED	mg/Kg		10	18			9.8
Shore Results							
1) MILL-SHORE	mg/Kg				-	-	-
2) R55-SHORE	mg/Kg				-	-	-
3) BWB-SHORE	mg/Kg	U	19	2	10		
4) ALLIANCE-SHORE	mg/Kg	U	1.5	U	1.2	U	0.84
5) ALMOND-SHORE	mg/Kg	1	U	U	U	U	U
6) BA-SHORE	mg/Kg	1.3	4.5				
7) SHERMAN-SHORE	mg/Kg	6.3	U	4.5	2.7	1.5	3.7
8) NUL-SHORE	mg/Kg						
9) ULB-SHORE	mg/Kg	2.4	8.1	2.1	1.7	5.2	2.3
10) SUL-SHORE	mg/Kg	1.4	2.1	6.5	2.3	1	1.2
Beach Results							
4) ALLIANCE-BEACH	mg/Kg	1	U	U	1.2	U	0.67
5) ALMOND-BEACH	mg/Kg	U	U	U	U	U	U
6) BA-BEACH	mg/Kg	U	U	U	U	U	U
9) ULB-BEACH	mg/Kg	0.9	1.1	1	U	0.91	1.1
10) SUL-BEACH	mg/Kg	U	U	U	U	U	0.53

NOTES:

U = undetected arsenic

Bold values represent detected arsenic concentrations; shaded and bolded values indicate arsenic exceedences as noted below:

Site Clean-up Level for Solids = 20 ppm (mg/Kg)

USEPA Drinking Water Criterion for Water = 10 ppb (µg/L)

"-" = no sample collected

TABLE 4-2. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010
VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sampling Year												
	1992*	1994*	1995*	1996*	1997*	1998*	1999*	May 2006*+	Nov 2006+	Sept 2007+	May 2009+	Nov 2009+	April 2010+
4) Alliance Beach								ND/ND	ND/ND	ND/ND		ND/ND	ND/ND
5) Almond Beach								ND/ND	ND/ND		ND/ND	ND/ND	ND/ND
6) "Bare A" Beach								ND/ND	ND/ND			ND/ND	
9) Union Lake Beach	NS	NS	NS		6.6	8.8	6	ND/ND	ND/ND		ND/ND		
10) South End Union Lake Beach	NS	NS	NS	NS	NS				ND/ND				
USEPA Drinking Water Criterion (ppb)	10	10	10	10	10	10	10	10	10	10	10	10	10

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the USEPA Drinking Water Criterion of 10 ug/L (ppb) for arsenic

NS = no sample collected; ND = not detected; below analytical limit

*Historical data from (USEPA/ERTC 1999) citation

**May 2006 data from (EA 2006a) citation

+ Data from 2006 through 2010 are presented as WAT1/WAT2

TABLE 4-3. ARSENIC CONCENTRATIONS (mg/Kg) IN BEACH (SOIL) SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010
VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sampling Year												
	1992*	1994*	1995*	1996*	1997*	1998*	1999*	May 2006*	Nov 2006**	Sept 2007	May 2009	Nov 2009	April 2010
4) Alliance Beach	NS	<i>0.45 ND</i>	2.2	0.89	0.49	1.1	0.59	1	ND	ND	1.2	ND	0.67
5) Almond Beach	NS	0.92	0.86	0.76	0.46	1	0.43	ND	ND	ND	ND	ND	ND
6) "Bare A" Beach	NS	<i>0.44 ND</i>	4	0.67	0.81	<i>0.41 ND</i>	<i>0.47 ND</i>	ND	ND	ND	ND	ND	ND
9) Union Lake Beach	NS	NS	NS	1.3	3.1	1.2	2.6	0.9	1.1	1	ND	0.91	1.1
10) South End Union Lake Beach	NS	NS	NS	NS	NS	2.3	<i>0.48 ND</i>	ND	ND	ND	ND	ND	0.53
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20	20	20	20

NOTE: Italics = arsenic undetected at indicated concentration (detection limit)

NS = No sample collected; ND = not detected; below analytical detection limit

No beach (soil) samples exceeded the Site Clean-up Level of 20 mg/Kg for solids

*Historical data from (USEPA/ERTC 1999) citation

**May 2006 data from (EA 2006a) citation

TABLE 4-4. ARSENIC CONCENTRATIONS (mg/Kg) IN SURFICIAL SEDIMENT SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sampling Year						
	1992*	1994*	1995*	1996*	1997*	1998*	1999*
4) Alliance Beach	11.1	9.65	7.75	1.6	2.2	4.2	6.7
5) Almond Beach	7.9	2	3.85	5.3	4.35	17	2.7
6) "Bare A" Beach	11.8	19.3	5.95	10.5	3.25		4.2
9) Union Lake Beach	NS	NS	NS	5	2.65	2.5	4.4
10) South End Union Lake Beach	NS	NS	NS	NS	NS	17.5	8.1
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20

Sample Location	Sampling Year											
	May 2006-sed	May 2006-shore	Nov 2006-sed	Nov 2006-shore	Sept 2007-sed	Sept 2007-shore	May 2009-sed	May 2009-shore	Nov 2009-sed	Nov 2009-shore	April 2010-sed	April 2010-shore
4) Alliance Beach	1.9	ND	1.3	1.5	ND	ND	ND	1.2	0.79	ND	2	0.84
5) Almond Beach	2.5	1	1.4	ND	1.3	ND	1.5	ND	0.94	ND	1.2	ND
6) "Bare A" Beach	1.2	1.3	2.6	4.5	2.3		2.3		ND			
9) Union Lake Beach		2.4		8.1		2.1		1.7		5.2		2.3
10) South End Union Lake Beach		1.4	10	2.1	18	6.5		2.3		1	9.8	1.2
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20	20	20

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the Site Clean-up Level of 20 mg/Kg (ppm) of arsenic for solids

NS = No sample collected; ND = not detected; below analytical detection limit

*Historical data from (USEPA/ERTC 1999) citation

5. REFERENCES

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APPENDIX A

ANALYTICAL RESULTS AND CHAIN- OF-CUSTODY (COC) FORMS FOR ARSENIC ANALYSES

Client: EA Engineering Science, and Technology, Inc.						Project Manager: Peggy Derrick		Parameters/Method Numbers for Analysis																		Chain of Custody Record	
15 Loveton Circle Sparks, MD 21152						Phone: 410-329-5126																				Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837	
Project Name: 2010 Vineland Spring Monitoring																									Phone: 732-906-6886		
Project#: 62305.01																									ATTN: Mr. John Birri/John Bourbon		
Page 1 of 3						No. of Containers	Arsenic EPA 200.7/6010B																				
Date	Time	Water	Sediment	Sample Identification																					Remarks		
4/6/10	1350		X	ULB-SHORE-040610				1	X																		
4/6/10	1355		X	ULB-BEACH-040610				1																			
4/6/10	1355		X	ULB-BEACH-HS-040610				1																Note: 28 day TAT required			
4/6/10	1355		X	ULB-BEACH-MSD-040610				1																JARS/BOTTLES WITH			
4/6/10	1645		X	JUL-SHORE-040610				1																"M" on lid are			
4/6/10	1650		X	JUL-BEACH-040610				1																28-day TAT			
			X	DUP-3				1																			
4/7/10	0920		X	BA-SHORE-040710				1																			
	0920		X	THE BA-SED-040710				1																			
	0930		X	BA-BEACH-040710				1																			
	0930		X	BA-BEACH-HS-040710				1																			
	0930		X	BA-BEACH-MSD-040710				1																			
	0940	X		BA-WATI-040710				1																			
	0941	X		BA-WAT2-040710				1																			
		X		DUP-4				1																			
	1215	X		ALMOND-WATI-040710				1																			
	1215	X		ALMOND-WATI-HS-040710				1																			
✓	1215	X		ALMOND-WATI-MSD-040710				1	✓																		

Sampled by: (Signature) <i>Todd Ward</i>	Date/Time 4/8/10 0915	Relinquished by: (Signature) <i>Todd Ward</i>	Date/Time 4/8/10 1700
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record		
Project Name: Vineland Fall Monitoring Project#: 62305.01 Page 2 of 3						No. of Containers Arsenic EPA 200.7/6010B													Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon	
Date	Time	Water	Sediment	Sample Identification														Remarks		
		X		DUP-5	1	X														
4/7/10	1220		X	ALMOND-SHORE-040710														Note: 28 day TAT required		
4/7/10	1225		X	ALMOND-SED-040710																
			X	DUP-1																
			X	DUP-2																
4/7/10	1520	X		ALLIANCE-WAT1-040710																
	1521	X		ALLIANCE-WAT2-040710																
	1525		X	ALLIANCE-SHORE-040710																
	1530		X	ALLIANCE-SED-040710																
	1535		X	ALLIANCE-BEACH-040710																
	1600	X		BWB-WAT1-040710																
	1601	X		BWB-WAT2-040710																
	1620		X	BWB-SED-040710																
✓	1610		X	BWB-SHORE-040710																
4/6/10	1700	X		PBLANK-01-040610																
4/7/10	0700	X		PBLANK-02-040710																
4/7/10	0705	X		TBLANK-040710																
4/7/10	1230		X	ALMOND-BEACH-040710																
Sampled by: (Signature) <i>Todd Ward</i>				Date/Time 4/8/10 0915		Relinquished by: (Signature) <i>Todd Ward</i>				Date/Time 4/8/10 1700										
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time										

[illegible]

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record		
Project Name: Vineland Fall Monitoring Project#: 62305.01 Page 2 of 7						No. of Containers Arsenic EPA 200.7/6010B													Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birr/John Bourbon	
Date	Time	Water	Sediment	Sample Identification														Remarks		
4/6/10	1500		X	SULT1-1	1	X														
	1505		X	SULT1-2														Note: 7 day TAT required		
	1510		X	SULT1-3																
	1515		X	SULT1-4																
	1520		X	SULT1-5																
	1525	X		SULT1-WAT1																
	1526	X		SULT1-WAT2																
	1530	X		SULT1-WAT3																
	1531	X		SULT1-WAT4																
	1550		X	SULT2-1																
	1555		X	SULT2-2																
	1600		X	SULT2-3																
	1605		X	SULT2-4																
	1610		X	SULT2-5																
	1615	X		SULT2-WAT1																
	1616	X		SULT2-WAT2																
	1620	X		SULT2-WAT3																
✓	1621	X		SULT2-WAT4	✓	✓														
Sampled by: (Signature) <i>Todd Ward</i>				Date/Time 4/7/10 1515		Relinquished by: (Signature) <i>Todd Ward</i>				Date/Time 4/8/10 1700										
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time										

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record			
Project Name: Vineland Fall Monitoring						No. of Containers	Arsenic EPA 200.7/6010B													Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon	
Project#: 62305.01																					
Page 3 of 7																					
Date	Time	Water	Sediment	Sample Identification														Remarks			
4/7/10	0743		X	BAT1-1	1	X															
	0745		X	BAT1-1-MS														Note: 7 day TAT required			
	0745		X	BAT1-1-MSD																	
	0750		X	BAT1-2																	
	0755		X	BAT1-3																	
	0800		X	BAT1-4																	
	0805		X	BAT1-5																	
			X	SED-DUPS																	
4/7/10	0815	X		BAT1-WAT1																	
	0816	X		BAT1-WAT2																	
	0820	X		BAT1-WAT3																	
	0821	X		BAT1-WAT4																	
	0830		X	BAT2-1																	
	0835		X	BAT2-2																	
	0840		X	BAT2-3																	
	0845		X	BAT2-4																	
	0850		X	BAT2-5																	
	0900	X		BAT2-WAT1		X															
Sampled by: (Signature) <i>Todd Ward</i>					Date/Time 4/7/10 1515		Relinquished by: (Signature) <i>Todd Ward</i>					Date/Time 4/11/10 1700									
Relinquished by: (Signature)					Date/Time		Received by Laboratory: (Signature)					Date/Time									

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record	
Project Name: Vineland Fall Monitoring Project#: 62305.01						No. of Containers Arsenic EPA 200.7/6010B												Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon	
Page 4 of 7																		Remarks	
Date	Time	Water	Sediment	Sample Identification															Remarks
4/7/10	0901	X		BAT2-WAT2	X														
	0907	X		BAT2-WAT3														Note: 7 day TAT required	
	0908	X		BAT2-WAT4															
	1030		X	ALMONDT1-1															
	1030		X	ALMONDT1-1-H5															
	1030		X	ALMONDT1-1-H5D															
	1035		X	ALMONDT1-2															
	1040		X	ALMONDT1-3															
	1045		X	ALMONDT1-4															
↓	1050		X	ALMONDT1-5															
			X	SED-DUP3															
4/7/10	1100	X		ALMONDT1-WAT1															
	1100	X		ALMONDT1-WAT1-H5															
	1100	X		ALMONDT1-WAT1-H5D															
	1105	X		ALMONDT1-WAT2															
	1110	X		ALMONDT1-WAT3															
↓	1111	X		ALMONDT1-WAT4															
		X		WATER-DUP3	↓	↓													
Sampled by: (Signature) Todd Ward				Date/Time 4/7/10 1515		Relinquished by: (Signature) Todd Ward				Date/Time 4/8/10 1700									
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time									

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record			
Project Name: 2010 Vineland Spring Monitoring						No. of Containers	Arsenic EPA 200.7/6010B													Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon	
Project#: 62305.01																					
Page 5 of 7																					
Date	Time	Water	Sediment	Sample Identification														Remarks			
4/7/10	1120		X	ALMONDT2-1	1	X															
	1120		X	ALMONDT2-1-HS														Note: 7 day TAT required			
	1120		X	ALMONDT2-1-HSD																	
	1125		X	ALMONDT2-2																	
	1130		X	ALMONDT2-3																	
	1135		X	ALMONDT2-4																	
↓	1140		X	ALMONDT2-5																	
			X	SED-DUP4																	
4/7/10	1150	X		ALMONDT2-WAT1																	
	1150	X		ALMONDT2-WAT1-HS																	
	1150	X		ALMONDT2-WAT1-HSD																	
	1155	X		ALMONDT2-WAT2																	
	1200	X		ALMONDT2-WAT3																	
↓	1201	X		ALMONDT2-WAT4																	
		X		WATER-DUP4																	
4/7/10	1325		X	ALLIANCE T1-1																	
↓	1325		X	ALLIANCE T1-1-HS																	
↓	1325		X	ALLIANCE T1-1-HSD	↓	↓															
Sampled by: (Signature) <i>Todd Ward</i>				Date/Time 4/7/10 1515		Relinquished by: (Signature) <i>Todd Ward</i>				Date/Time 4/8/10 1700											
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time											

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152				Project Manager: Peggy Derriek Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250		Parameters/Method Numbers for Analysis												Chain of Custody Record		
Project Name: Vineland Fall Monitoring Project#: 62305.01						No. of Containers Arsenic EPA 200.7/6010B													Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon	
Page 6 of 7																				
Date	Time	Water	Sediment	Sample Identification																
4/7/10	1330		X	ALLIANCE T1-2	1		X													
	1335		X	ALLIANCE T1-3														Note: 7 day TAT required		
	1340		X	ALLIANCE T1-4																
↓	1345		X	ALLIANCE T1-5																
			X	SED-DUP1																
4/7/10	1400	X		ALLIANCE T1-WAT1																
	1400	X		ALLIANCE T1-WAT1-MS																
	1400	X		ALLIANCE T1-WAT1-MSD																
	1401	X		ALLIANCE T1-WAT2																
	1407	X		ALLIANCE T1-WAT3																
↓	1408	X		ALLIANCE T1-WAT4																
		X		WATER-DUP1																
4/7/10	1425		X	ALLIANCE T2-1																
	1425		X	ALLIANCE T2-1-MS																
	1425		X	ALLIANCE T2-1-MSD																
	1430		X	ALLIANCE T2-2																
	1435		X	ALLIANCE T2-3																
↓	1440		X	ALLIANCE T2-4	↓	↓														
Sampled by: (Signature) <i>Todd Ward</i>				Date/Time 4/7/10 1515		Relinquished by: (Signature) <i>Todd Ward</i>				Date/Time 4/8/10 1700										
Relinquished by: (Signature)				Date/Time		Received by Laboratory: (Signature)				Date/Time										

[illegible]

[illegible]

APPENDIX B

FIELD DOCUMENTATION AND LOGBOOK

VINELAND

Spring Monitoring 2010

Additional Beach
Transects

31 March 2010 - mobile
Bluewater anchored up current
from diving site.
sampled at approx 1 meter
below surface of water.

Temp	Cond	Sal	DO	pH	Turb
8.52	36.3	26.72	6.60	8.11	12.7
77.8	49.11	37.95	3.02	7.81	13.0
77.1	49.19	38.04	2.17	7.83	13.6

Leave MODMS and head to TQB

6 April 2010

VINELAND Spring 2010 Monitoring
and Additional BEACH TRANSECTS

1130 - arrived Union Lake Beach Tennis and
Sailing Club

Coordinates
NJ NAD83, feet

Additional Beach Transects						NJ NAD 83, TSS 8
Sample ID	Depth (ft)	N	E	Time	Approx. Dist. from	
ULBT1-1	2.7	210370.1	335317.9	1215	66	
-2	2.65	210358.9	335327.7	1216	53	
-3	2.4	210351.6	335336.3	1217	40	
-4	1.9	210342.9	335343.9	1218	27	
-5	0	210316.3	335352.1	1219	0	
ULBT1-WAT1	2.7	210370.1	335317.9	1225	66	
-WAT2	2.7			1230		
-WAT3	0			1257		
-WAT4	0	210316.3	335352.1	1258	0	
ULBT2-1	2.8	210436.6	335363.1	1235	51	
-2	2.5	210423.5	335372.5	1236	38	
-3	2.1	210415.9	335380.4	1237	25	
-4	1.7	210403.1	335390.5	1238	12	
-5	0.6	210383.4	335410.9	1239	0	
ULBT2-WAT1	2.8 ft	210436.6	335352.1	1240	66	
-WAT2				1245		
-WAT3	0.6 ft			1240		
-WAT4		210383.4	335410.9	1241	0	

Note: WAT 1 and WAT3 - pre-agitated
WAT 2 and WAT4 - post-agitated

6 April 2010

Union Lake Beach

Monitoring Samples

Sample ID	Time	N	E	Depth
ULB-Shore-040610	1350	210	335	1.8 ft
ULB-Beach-040610	1355	210	335	1.8 ft
ULB-Beach-HS-040610	1355	210	335	1.8 ft
ULB-Beach-HSD-040610	1355	210	335	1.8 ft

1400 - wind, qual @ ULB

Temp = 19.62 °C pH = 6.6

Cond = 0.1 mS/cm Turb = 4.4 NTU

Sal = 0.05 ppt

DO = 7.74 mg/L

1430 - arrive @ South End Union Lake

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Distance (ft)
SULT1-1	1400	3.0	208,789.3	336,509.1	92
-2	1405	2.5	208,791.4	336,516.9	32
-3	1410	1.9	208,791.4	336,523.6	22
-4	1415	1.2	208,794.8	336,534.5	12
-5	1420	0	208,795.8	336,546.6	0
SULT1-WAT1	1425	3.0	208,789.3	336,509.1	92
-WAT2	1426				
-WAT3	1430				
-WAT4	1431	0	208,795.8	336,546.6	0

6 April 2010

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Distance (ft)
SULT2-1	1450	2.9	208,872.1	336,518.7	41
-2	1455	2.3	208,872.9	336,524.0	32
-3	1500	1.9	208,873.4	336,530.5	23
-4	1505	1.4	208,874.9	336,536.1	14
-5	1510	0.4	208,878.5	336,530.1	0
SULT2-WAT1	1515	2.9	208,872.1	336,518.7	41
-WAT2	1516				
-WAT3	1520				
-WAT4	1521	0.4	208,878.5	336,530.1	0

Monitoring Samples

Sample ID	Time	N	E	Depth
SUL-Shore-040610	1645	208,754.9	336,524.5	2.0
SUL-Beach-040610	1650	208,754.9	336,524.5	-
DUP-3				-

1635 - wind, qual @ South Union Lake Beach

Temp = 19.76 pH = 6.41

Cond = 0.101 Turb = 1.7

Sal = 0.05

DO = 7.62

1700 - PBLANK-01-040610 equip. blank

7 April 2010

0700 - PBLANK - 02 - 040710

0705 - TTBLANK - 040710

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. DWT (ft)
BAT1-1	0745	3	237,978.5	330,371.4	19
-1-MC	0745	"	"	"	19
-1-MSD	0745	"	"	"	19
-2	0750	2.5	237,979.3	330,372.8	14.5
-3	0755	2.2	237,978.8	330,375.5	10
-4	0800	2.2	237,980.1	330,380.8	5.5
-5	0805	0.6	237,979.1	330,387.1	0
-6 SED-DUP5	0.6				
BAT1-WAT1	0815	3ft	237,978.5	330,371.4	19
-WAT2	0816				
-WAT3	0820	7ft	237,979.1	330,387.1	0
-WAT4	0821				

0917 - water qual @ BA Beach

Temp = 18.77 DO = 6.19

Cond = 0.110 PH = 6.17

Sal. = 0.05 Turb. = 0.2

7 April 2010

Additional Beach Transects

Sample ID	Time	Depth	N	E	Approx. DWT (ft)
BAT2-1	0830	3.6	238,001.7	330,370.2	20
-2	0835	2.6	238,007.2	330,372.3	15
-3	0840	2.5	238,007.5	330,376.3	10
-4	0845	1.7	238,007.2	330,381.1	5
-5	0850	0.7	238,011.1	330,382.7	0
BAT2-WAT1	0900	3.6	238,001.7	330,370.2	20
-WAT2	0901				
-WAT3	0907	0.7	238,011.1	330,382.7	0
-WAT4	0908				

MONITORING

BA-SHORE - 040710	0920	N 238004.7	Depth = 52.1
BA-SED - 040710	0928	N 238008.1	Depth = 2.7 ft
BA-BEACH - 040710	0930	N 238012.4	
-MS - 040710	0930	E 330401.9	
-MSD - 040710	0930		
BA-WAT1 - 040710	0940	N 238004.7	
BA-WAT2 - 040710	0941	N 238008.1	
-DUP-4		E 330366.5	3.7 ft

7 April 2010

0958 - arrive @ Almond Beach

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Dist. (ft)
ALMONDT1-1	1030	2.7	241, 832.4	329, 508.3	50
-1-M1	1030	2.7	"	"	"
-1-MSD	1030	2.7	"	"	"
-2	1035	2.4	241, 833.1	329, 518.2	38
-3	1040	2.4	241, 834.0	329, 525.1	26
-4	1045	2.3	241, 834.7	329, 534.8	14
-5	1050	0	241, 834.7	329, 532.5	0
SED-DUP3					

ALMONDT1-WAT1 1100

-WAT1-M1 1100	2.7	241, 832.4	329, 508.3	50
-WAT1-MSD 1100				
-WAT2 1105				
-WAT3 1110				
-WAT4 1111	0	241, 837.3	329, 552.5	0
WATER-DUP3				

1206 - water qual @ Almond Beach

Temp = 19.65 DO = 8.35

Cond = 0.110 pH = 6.16

Sal = 0.05 Turb = 0.7

7 April 2010

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Dist. (ft)
Almond T2-1	1120	3.3	241, 834.6	329, 524.8	26
-1-M1	1120	"	"	"	"
-1-MSD	1120	"	"	"	"
-2	1125	2.65	241, 834.1	329, 521.4	19.5
-3	1130	2.2	241, 835.8	329, 522.0	13.0
-4	1135	1.5	241, 836.0	329, 524.5	6.5
-5	1140	0	241, 836.4	329, 525.5	0
SED-DUP4					

Almond T2-WAT1 1150

-WAT1-M1 1150	3.3	241, 834.6	329, 524.8	26
-WAT1-MSD 1150				
-WAT2 1155				
-WAT3 1200				
-WAT4 1201	0	241, 836.4	329, 530.5	0
WATER-DUP4				

MONITORING

ALMOND - WAT1 - 040710 1155	2.4 ft depth	241, 838.0	329, 522.0
-M1-040710 1215			
-MSD-040710 1215			
-WAT2-040710 1216			
DUP-5			
ALMOND - SHORE - 040710 1220		241, 835.6	329, 521.4
DUP-1			

ALMOND - SED - 040710 1225

↳ DUP-2

241, 838.0 329, 522.0
D = 2.4 ft

7 April 2010

MONITOR

ALMOND-BEACH-040710 1230 N 241, 844.7

-MS-040710 1230 E 329, 555.8

-MSD-040710 1230

1300- Arrive @ Alliance Beach Additional Beach Transect

Sample ID	Time	Depth	N	E	Approx. Dist.
Alliance T1-1	1325	3.0	243, 960.7	328, 590.1	38

-1-MS 1325 "

-1-MSD 1325 "

-2 1330 2.5 243, 962.7 328, 581.5 28.5

-3 1335 1.9 243, 966.4 328, 574.0 20.8 TW

-4 1340 2.3 243, 970.7 328, 568.0 16.5 TW

-5 1345 0 243, 976.4 328, 557.6 0

SED-DUP1 0 " " 0

Alliance T1-WAT1 1400

-WAT1-MS 1400 3.0 243, 960.7 328, 590.1 38

-WAT1-MSD 1400

T1-WAT2 1401

T1-WAT3 1407

T1-WAT4 1408 0 243, 976.4 328, 557.6 0

WATER-DUP1

1602- Arrive @ Alliance Beach

Temp = 21.10 DO = 10.26

Cond = 0.111 pH = 6.18

Sal = 0.05 Turb = 0.1.2 TW

7 April 2010

Sample ID	Time	Depth	N	E	Approx. Dist.
Alliance T2-1	1425	3.0	243, 915.0	328, 574.8	35
-1-MS 1425	"	"	"	"	"
-1-MSD 1425	"	"	"	"	"
-2 1430	2.75	243, 917.5	328, 568.5	26	
-3 1435	2.4	243, 919.4	328, 560.3	17	
-4 1440	1.6	243, 922.4	328, 553.2	8	
-5 1445	0	243, 924.9	328, 544.3	0	

SED-DUP2

Alliance T2-WAT1 1455

-WAT1-MS 1455 3.0 243, 915.0 328, 574.8 35

-WAT1-MSD 1455

-WAT2 1456

-WAT3 1500

-WAT4 1501 0 243, 924.9 328, 544.3 0

WATER-DUP2

MONITOR

ALLIANCE-WAT1-040710 1520 N 243, 915.0 328, 574.8 35

ALLIANCE-WAT2-040710 1521

ALLIANCE-SHORE-040710 1525 N 243, 945.0 328, 570.0 0 = 2.7 K

ALLIANCE-SED-040710 1530 E 328, 574.8 0 = 3.25 K

ALLIANCE-BEACH-040710 1535 N 243, 946.0 328, 570.0

7 April 2010

MONITOR

BWB Confluence

1600 ⁰⁴⁰⁷¹⁰
 BWB-WAT1 - N 244849.1 E 329104.7 D = 2.3
 1601 - WAT2 - ⁰⁴⁰⁷¹⁰ " " " "
 1620 - BWB-SED - 040710 N 244849.1 D = 2.3
 E 329104.7
 1610 - BWB-SHORE - 040710 N 244878.9
 E 329129.9

1600 - Wat. qual. @ BWB
 Temp = 21.18 DO = 9.91
 Cond = 0.111 pH = 6.34
 Sal = 0.05 Turb = 4.8

8 April 2010

0800 - PBlank - 03-040810

NUL-WAT1-040810 ⁰⁸²⁰ N 219637.5 D = 5.54
¹⁰²⁰
 -WAT2-040810 ⁰⁸²¹ E 331304.8
¹⁰²¹
 NUL-SED-040810 0824
 -SHORE-040810 0830 - N 219449.1 D = 2.04
 E 331334.7

8 April 2010

DLR-WAT1-040810 0840 - N 210487.8
 -WAT2- 0842 E 335160.0
 -SED- 0850 - Depth = 12.7 ft

NUL-WAT1-040810 0903 N 208729.7
 -WAT2- 0906 E 336396.6
 -SED- 0910 Depth = 8.5

0941 - Wat. qual. @ North Union Lake
 Temp = 19.36 DO = 6.32
 Cond = 0.133 pH = 6.5
 Sal = 0.06 Turb = 0.5

19 May 2010

Vineland Spring Monitoring 2010

Sherman Ave. location

Sherman-Sed-051910 0940

Sherman-Shore-051910 0945

Sherman-Wat1-051910 0950

Sherman-Wat2-051910 0951

Coordinates

N

E

Sherman-Sed-051910 224398.4 330555.7

-Shore-051910 224387.0 330561.7

-WAT1-051910 224398.4 330555.7

-WAT2-051910 224398.4 330555.7

1008-Wat. qual. @ Sherman Ave.

Temp. = 13.8 °C

Cond. = 0.099 mS/cm

Sal. = 0.06 ppt

DO = 7.47 mg/L

pH = 6.20

Turb = 10.6 NTU

APPENDIX C

**USEPA REGION 2 DESA - STANDARD
OPERATING PROCEDURES C-109 AND
C-116**



STANDARD OPERATING PROCEDURE

DETERMINATION OF METALS IN AQUEOUS, TCLP EXTRACTS, SOIL/SEDIMENT, SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE SAMPLES BY TRACE (AXIAL CONFIGURATION) INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY

Signature and Title

Prepared by: _____
Ness Tirol, Chemist, OICS Date

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Reviewed by: _____
Signature Date

Reviewed by: _____
Signature Date

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Appendices:

Appendix A : Data Work-Up

Table(s):

Table 1: Standard Solutions Preparation

Table 2: Reporting Limits

**DETERMINATION OF METALS IN AQUEOUS, TCLP EXTRACT, SOIL/SEDIMENT,
SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE
MATRICES BY TRACE (AXIAL CONFIGURATION)
INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY**

1. Scope and Application

- 1.1 This SOP is applicable to the preparation of environmental samples, including aqueous, TCLP extract, soil/sediment, biological tissue, and waste oil/organic solvents, for the determination of the following metals:

Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cu, Cr, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Se, Sb, Si, Sn, Sr, Ti, Tl, V, and Zn

Note - This SOP is not applicable to the preparation and analysis of drinking water compliance monitoring samples. The procedure for the preparation and analysis of drinking water compliance monitoring samples using the Trace ICAP is detailed in Laboratory SOP DW-5.

- 1.2 All analysts must satisfactorily perform an initial demonstration of capability (DOC) by meeting the method performance criteria in Sec. 13.1 prior to performing sample analysis using this SOP.
- 1.3 The standard reporting limits for both aqueous and non-aqueous samples are listed in Table 2.
- 1.4 This SOP is based on EPA Method 200.7, Revision 4.4.

2. Summary of SOP

- 2.1 Environmental samples, e.g., aqueous, TCLP extracts, soil/sediment, sludges, waste oil/organic solvent, and biological tissue, are digested in a mixture of acids, according to the procedures described in U. S. Environmental Protection Agency, Region 2, SOP C-116 *"Preparation of Aqueous, TCLP Extracts, Soil/Sediment/Sludge, Waste Oil/Organic Solvents, and Biological Tissue Matrices by Block Digestion."*

- 2.2 The analysis described in this method involves multi-element determinations by ICAP-AES using a simultaneous Thermo-Jarrell Ash Trace Purge ICAP. The instrument measures characteristic atomic-line emission spectra by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element specific emission spectra are produced by a radio-frequency inductively coupled argon plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the line spectra are monitored at specific wavelengths by a photomultiplier tube (PMT). Photocurrents from the pmt are processed and controlled by a computer system. A background correction technique is required to compensate for background contribution to the determination of the analytes. Background must be measured adjacent to the analyte wavelength during analysis. Various interferences must be considered and addressed appropriately.

3. Definitions

See SOP G-15 for definitions.

4. Interferences

- 4.1 Several types of interference effects may contribute to inaccuracies in the determination of trace elements. They can be summarized as follows:
- 4.1.1 Spectral Interferences - these interferences can be categorized as 1) overlap of a spectral line from another element; 2) unresolved overlap of molecular band spectra; 3) background contribution from continuous or recombination phenomena; and 4) background contribution from stray light from the line emission of high concentration elements. The first of these effects can be compensated for by utilizing a computer correction of the raw data, requiring the monitoring and measurement of the interfering element. The second effect may require selection of an alternate wavelength. The third and fourth effects can usually be compensated for by a background correction adjacent to the analyte line. In addition, users of simultaneous multi element instrumentation must assume the responsibility of verifying the absence of spectral interference from an element that could occur in a sample but for which there is no channel in the instrument array. For this purpose, linear relations between concentration and intensity for the analytes and the interferences must be demonstrated over the range of interest.
- 4.1.2 Physical Interferences - these interferences are generally considered to be effects associated with the sample nebulization and transport processes. Such properties

as change in viscosity and surface tension can cause significant inaccuracies especially in samples which may contain high dissolved solids and/or acid concentrations. The use of a peristaltic pump may lessen these interferences. If these types of interferences are operative, they must be reduced by dilution of the sample. Another problem which can occur from high dissolved solids is salt buildup at the tip of the nebulizer. This affects aerosol flow-rate causing instrumental drift. Wetting the argon prior to nebulization, the use of a tip washer, or sample dilution have been used to control this problem. This problem can also be alleviated by using a Bergener nebulizer instead of a Meinhardt nebulizer. Also, it has been reported that better control of the argon flow rate improves instrument performance. This is accomplished with the use of mass flow controllers.

4.1.3 Chemical Interferences - these interferences are characterized by molecular compound formation, ionization effects and solute vaporization effects. Normally these effects are not pronounced with the ICP technique, however, if observed they can be minimized by careful selection of operating conditions (that is, incident power, observation position, and so forth), buffering of the sample and matrix matching. These types of interferences can be highly dependent on matrix type and specific analyte element.

4.2 Generally, whenever a new or unusual sample matrix is encountered, a series of tests on the matrix-type are performed, e.g., background check of the sample, sample overlay with standards, etc., prior to analyzing samples associated with that matrix. If the problems associated with the new matrix cannot be overcome, the sample must either be diluted appropriately (and the Reporting Limit raised accordingly) or analyzed by an acceptable different method.

5. Safety

The toxicity and carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized by good laboratory practices. Normally accepted laboratory safety practices should be followed during reagent preparation and instrument operation. Always wear safety glasses or full-face shield for eye protection when working with these reagents. Each laboratory is responsible for maintaining a current safety plan, a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this SOP.

6. Apparatus and Materials

6.1. Inductively coupled argon plasma:

- 6.1.1 Thermo Jarrell Ash (TJA) ICAP 61E Trace Purge Analyzer (with an axial torch) controlled by a computer.
- 6.1.2 TJA radio-frequency generator.
- 6.1.3 High purity (99.99%) liquid argon.
- 6.1.4 A variable speed peristaltic pump which is used to deliver both standards and samples to the nebulizer.
- 6.1.5 Computer controlled mass flow controllers which regulate the argon flow rates.

6.2. A balance which has the capability to measure 0.1mg.

6.3. Labware (See Section 6.10 of EPA Method 200.7 Rev. 4.4).

7. Reagents and Solutions

7.1 Reagents - All reagents must be of high purity and suitable for trace metals analysis.

- 7.1.1 Hydrochloric acid, concentrated - HCl (GFS HCl, 37% Reagent ACS or equivalent)
- 7.1.2 Nitric acid, concentrated - HNO₃ (GFS HNO₃, Redistilled or equivalent)
- 7.1.3 Reagent grade water – ASTM Type I Water

7.2 Solutions - Refer to Table 1 for standard solutions preparation summary.

7.2.1 Calibration Stock Standard Solutions - Claritas Custom Standards manufactured by Spex CertiPrep under UL ISO 9001 Quality Assurance Program.

- 7.2.1.1 Calibration Standard 1 - SPEX CertiPrep Custom Claritas Standard (250 ppm of Ag, As, B, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, Ti, Tl, V, and Zn) or equivalent.
- 7.2.1.2 Calibration Standard 2 - SPEX CertiPrep Custom Claritas Standard (250 ppm of Al, Ca, Fe, Mg, K, Na and Si) or equivalent.

7.2.2 Working Calibration Solution – The Working Calibration Solution is prepared from the Stock Calibration Standard Solutions (7.2.1) to a final concentration of 1,000 ug/L for all elements except for Al, Ca, Fe, K, Mg, Na and Si which are 10,000 ug/L. The solution is in 2% HNO₃ and 5% HCl.

- 7.2.3 Blanks** – Four types of blanks are required for the analysis. The (1) calibration blank is used in establishing the analytical curve, the (2) initial calibration blank/continuing calibration blank (ICB/CCB) run after the calibration check standards to assess carryover, (3) a rinse blank is used to flush the instrument uptake system and nebulizer between standards, check solutions, and samples to reduce memory interferences and (4) a Laboratory Reagent Blank/Prep Blank (LRB/PB) is used to assess possible contamination from the sample preparation procedure and to assess spectral background.
- 7.2.3.1** The calibration blank is prepared by adding HNO₃ and HCl to reagent grade water to the same concentrations used for the calibration standard solution.
 - 7.2.3.2** The rinse blank is prepared by acidifying reagent grade water to the same concentration of the acids as used in the calibration blank.
 - 7.2.3.3** The ICB and CCB are prepared by acidifying reagent grade water to the same concentration of acids as used in the calibration blank
 - 7.2.3.4** Laboratory reagent blank (LRB)/Prep blank (PB) - must contain all the reagents in the same volumes as used in digesting the samples. The LRB/PB must be carried through the same preparation scheme as the samples including digestion, if applicable.
- 7.2.4 Initial Calibration Verification/Continuing Calibration Verification Solution (ICV/CCV)** – These verification standard solutions are used to initially and periodically verify instrument performance during analysis. The ICV/CCV stocks must be obtained from a source different from the calibration stock standard solutions and prepared in the same acid mixture as the calibration standards. The concentration of the analytes in the ICV/CCV solution is 200 ug/L for all elements except Al, Ca, Fe, K, Mg, Na and Si which is 5,000 ug/L.
- 7.2.4.1** Claritas Custom Standard - ICV1, 250ppm (Ag, As, B, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, Ti, Tl, V, and Zn)
 - 7.2.4.2** Claritas Custom Standard - ICV2, 250ppm (Al, Ca, Fe, K, Mg, Na, Si)
- 7.2.5 Low Level Check (ICV/50, ICV/20 and ICV/10)** – The low level checks are used to initially and periodically verify instrument performance at lower concentration levels. The concentration of the analytes should be at or above the analyte reporting limit. Al, Ca, Fe, K, Mg, and Na are not evaluated in these low level check standards. The instrument performance low level checks are at 2%, 5% and 10% dilution of the ICV. The concentration of analytes of concern in ICV/50 are 4 ug/L for ICV1 elements and 100 ug/L for ICV2 elements; ICV/20 are 10 ug/L for the ICV1 elements and 250ug/L for ICV2 elements. The concentration

of the analytes of concern in the ICV/10 are 20 ug/L for ICV1 and 500 ug/L for ICV2.

- 7.2.6 Internal Standard Solution (5ppm Y; Li 400ppm) – The normal calibration procedure for arc/spark involve the use of an internal standard. An element not found in the matrix being analyzed is added to each standard and each sample. Should the volume of aspirated sample change a corresponding intensity change will occur for all elements. Since the ratio remains constant, the possible error is eliminated.
- 7.2.7 Profiling Solution (5ppm As) – External problems like temperature and humidity changes can cause short and long term drift. This drift is due to the expansion or contraction of the focal curve with the result that the analytical line moves in relation to the measuring device. Periodic profiling corrects for this drift.
- 7.2.8 Inter-Element Correction (IEC) Solution (previously known as Interferents Only Solution IOS) - When inter-element corrections are applied, a spectral interference check solution is needed containing concentrations of the interfering elements at levels that will provide an adequate test of the correction factors.

8. Sample Collection, Preservation, Storage and Holding Time

- 8.1 Sample Collection - Samples must be collected in plastic or glass containers.
- 8.2 Preservation and Storage
 - 8.2.1 Aqueous samples - the samples are preserved using concentrated HNO_3 . The preservation is performed either a) in the field at the time of collection, or b) in the Laboratory upon receipt (within one business day). If the samples are preserved in the Laboratory, the samples must be held for sixteen hours after acidification and then verified to a $\text{pH} < 2$ prior to sample processing. If the sample pH is verified to be $\text{pH} > 2$ after the sixteen hours, additional HNO_3 must be added and the sample held for an additional sixteen hours until verified to a $\text{pH} < 2$. The samples are stored at room temperature.
 - 8.2.2 Soil/Sediment/Sludge samples - these samples are preserved in a refrigerator at $\leq 4^\circ\text{C}$. Alternatively, the samples maybe stored at $\leq -20^\circ\text{C}$ in a freezer.
 - 8.2.3 Biological Tissue samples - The samples are stored at $\leq -20^\circ\text{C}$ in a freezer.
 - 8.2.4 Waste Oil/Organic Solvents - these samples do not require any preservation. The

samples are stored at room temperature.

8.2.5 Drum Samples - no temperature requirement for these samples.

8.3 Holding time

8.3.1 Aqueous samples must be prepared and analyzed within six months of collection.

8.3.2 Soil/Sediment/Sludge samples must be digested and analyzed within six months of collection.

Note: If soil/sediment samples are stored at $\leq -20^{\circ}\text{C}$, the holding time is extended. The samples must be prepared within 12 months of collection and analyzed within 6 months of digestion.

8.3.3 Biological Tissue samples must be digested within 12 months of collection and analyzed within 6 months of digestion.

8.3.4 Waste Oil/Solvent samples - a holding time is not established for the digestion or analysis of these samples.

8.3.5 Drum Samples do not require any holding time.

9. Sample Preparation

All Environmental samples, e.g., aqueous, soil/sediment, waste oil/organic solvent, and biological tissue, including NPDES wastewater compliance monitoring samples, are digested in a mixture of acids using the procedures described in SOP Number C-116 "Digestion of Metals Aqueous, TCLP Extracts, Soil/Sediment, Sludge, Waste Oil/Organic Solvents, TCLP Extracts and Biological Tissue Matrices by DigiBloc".

10. Instrument Operating Conditions

Before using this method, the following procedure is followed to optimize plasma conditions. The analyst should follow Thermo Electron's instructions unless other conditions provide better performance.

10.1 Before lighting the plasma, make sure the following settings are in place:

Auxiliary gas- low
Nebulizer flow rate ~ 0.60L/min
Pump Rate ~ 140 rpm

Internal standard solution with a buffer

It is important to ensure that there is no pulsing in any of the lines.

- 10.2 After lighting the plasma, make sure the above settings have not changed and verify that the RF power setting is at 950 W.
- 10.3 Allow the plasma to become stable. At a minimum, wait 30 minutes before proceeding.
- 10.4 Optically profile the spectrometer by aspirating a 5ppm arsenic solution. The spectrum shifter must be between -0.05 and +0.05.

11. Sample Analysis

- 11.1 Configure the instrument settings to those in Section 10.
- 11.2 Fill in the sample ID file.
- 11.3 After the plasma has become stable, standardize the instrument using the mixed calibration standard solution (Section 7.2.2) and the calibration blank (Section 7.2.3.1). The average of three readings is to be used. Flush the system with the rinse blank for a minimum of 60 seconds between each standard.
- 11.4 After the completion of the initial requirements, samples should be analyzed in the same operational manner used in the standardization routine with a rinse blank also being used between all sample solutions, LFBs/LCSs-Aqueous, LFM/MSs, and check solutions.
- 11.5 During the analysis of samples, the laboratory must comply with the required quality control in Sections 14. Only for the "direct analysis" of drinking water is the sample digestion step of the LRB/PB, LFB/LCS-Aqueous, and LFM/MS not required.
- 11.6 Sample analysis consists of the following:

Calibration Blank

Mixed Standard

IPC/ICV

IPB/ICB (Calibration Blank solution)

Low Check Sample/ICV/50, ICV/20 and ICV/10 (either solution at or below the analyte MCL excluding Al, Fe, Mg, and Na)

SIC/IOS

LRB/PB
LFBs/LCSs
Samples
LFM/MS
IPC/CCV -must be analyzed at a minimum of every 10 samples
IPB/CCB
ICV/50, ICV/20, ICV/10
SIC/IOS

Note : The IPC/CCV and IPB/CCB must be analyzed at a minimum of every 10 analyses and at the end of each analysis run.

11.7 Determined sample analyte concentrations that are 90% or more of the upper limit of the analyte LDR must be diluted with reagent grade water that has been acidified in the same manner as the calibration blank and reanalyzed. See Section 11.4.7. of EPA Method 200.7, Rev. 4.4.

11.8 Report Data as directed in Section 12.

12. Data Analysis and Calculations

12.1 Refer to Appendix A for detailed instructions for data workup and/or upload into LabWorks.

12.2 Aqueous Samples - Undigested

All dilution factors required as a result of dilutions made during analysis are applied at the instrument. Therefore, all of the aqueous sample results generated from the analysis (in ug/L) can be reported directly from the instrument. All results are reported to two significant figures and, in most cases, are reported using reporting limits listed in Table 2.

12.3 Aqueous Samples - Digested

Dilution factors required as a result of dilutions made during analysis are also applied at the instrument. Therefore, all of the aqueous sample results, in ug/L, generated from the analysis can be reported directly from the instrument. All results are reported to two significant figures and, in most cases, are reported down to the standard reporting limit listed in Table 2.

12.4 Non-Aqueous Samples

All dilution factors required as a result of dilutions made during analysis are applied at the instrument. Therefore, all of the results, in ug/L, generated from the analysis can be used directly from the instrument. These "ug/L" results must then be converted to "mg/Kg" results. The ug/L result is multiplied by the final digestate volume in Liters, usually 0.050 L, and divided by the sample mass in grams, usually 0.50 g (the specific sample volume and mass are recorded in the metals sample preparation log book). For dry weight calculation, the mg/Kg results must be divided by the decimal version of the percent solids, e.g., 90% is 0.90. Refer to to SOP G-23 for Percent Dry Solids.

All mg/Kg results are reported to two significant figures and, in most cases, are reported using the reporting limits listed in Table 2, adjusted for percent solids correction for dry weight basis.

13. Method Performance

An initial demonstration of capability (DOC) must be performed each time there is a significant change in the chemistry of the method, a major modification to an existing instrument, or a new instrument is installed. A DOC is performed by each analyst designated to analyze samples using this method. An annual check must subsequently be performed and documented for each analyst using this method.

13.1 Accuracy and Precision

13.1.1 Initial Demonstration of Capability

An initial demonstration of capability study must be conducted for this method for each analyst using this method. The study consisted of the analysis of four standards which are from a source independent of the standard curve. The results of the standards must be within the acceptance criteria supplied by the manufacturer or within 10% if none are specified. The % RSD should be within 20%. The results of the accuracy and precision study (true value, % recovery, standard deviation and % RSD) are maintained by the Quality Assurance Officer for each analyst and are located in the Central Branch File.

13.1.2 Continuing Demonstration of Capability

An annual continuing demonstration of capability study must be performed and documented. It may consist of either successfully analyzing a PT sample or analyzing

2 sets of AQC standards to within control limits as stated in section 13.1.1. The results of the continuing accuracy and precision study (true value, % recovery, standard deviation and % RSD or final report from the PT provider) are maintained by the Quality Assurance Officer for each analyst and are located in the Central Branch File.

13.2 Method Detection Limit (MDL)

An MDL Study must be conducted for this method. The study is based on the requirements listed in 40 CFR Part 136 Appendix B. Specific procedures for conducting an MDL study can be found in SOP # G-8. The MDL Study comprised the analysis of seven reagent grade water samples fortified at a level between 2-3x the detection limit. The results of the MDL determination (true value, average concentration, standard deviation and calculated MDL) are maintained by the Quality Assurance Officer for each method and are located in the Central Branch File.

13.3 Linear Dynamic Range (LDR)

The LDR must be determined by generating a normal linear calibration curve followed by the analysis of successively higher standard solutions. The results of these standard solutions are used to calculate % recovery. This is conducted until the % recovery fell below 90%. The last standard that had a % recovery of at least 90% is identified as the LDR limit.

The results of the LDR Study are maintained in a file next to the instrument. The LDR results must be below or equal to that listed as the upper range in EPA Method 200.7.

14. Quality Control

14.1 Calibration Curve

Acceptance Criteria - A calibration blank and one mixed standard are used to standardize the instrument. After standardization, the ICV and ICB are used to determine acceptance.

Corrective Action - If the results of the ICV or ICB are unacceptable, analysis must be discontinued, the cause determined and/or in the case of drift the instrument re-calibrated.

14.2 Initial Calibration Verification (ICV).

Acceptance Criteria - Analyze the ICV solution from a separate identifiable source (different lot number or vendor from that of calibration standards) immediately following

the calibration. The result of the ICV solution must be within $\pm 5\%$ of the true value for NPDES compliance monitoring samples and $\pm 10\%$ for all other samples.

Corrective Action - If the calibration cannot be verified within the specified limits, re-analyze the ICV solution. If the results of the second analysis of the IPC/ICV solution is not within the acceptance limits for both types of samples (NPDES compliance monitoring samples and other samples), the analysis must be evaluated and the cause determined and the instrument re-calibrated. If the results of the second analysis of the IPC/ICV solution is not within the acceptance limits of NPDES requirements but within the acceptance limits for other program samples, a case narrative must be issued for samples that are non-compliant.

14.3 Continuing Calibration Verification (CCV)

Acceptance Criteria - Analyze the CCV solution, from the same source as that used for the ICV, after a maximum of ten samples and at the end of the sample run. The results of each CCV solution must be within $\pm 10\%$ of the true value for NPDES compliance monitoring samples ($\pm 20\%$ for all other samples).

Corrective Action - If the calibration cannot be verified within the specified limits, re-analyze the CCV solution. If the results of the second analysis of the CCV solution is not within the acceptance limits, the analysis must be discontinued, the cause determined and the instrument re-calibrated. All samples following the last acceptable CCV solution must be reanalyzed.

14.4 Initial Calibration Blank/Continuing Calibration Blank (ICB/CCB)

Acceptance Criteria - Analyze the calibration blank immediately following each calibration and after every CCV. All ICB/CCBs results must be $<$ the |Reporting Limit|.

Corrective Action - If the result of the ICB/CCB is $>$ |Reporting Limit|, the analysis should be stopped the problem identified, and the ICB/CCB reanalyzed. If the ICB/CCB results remain $>$ |Reporting Limit|, the instrument must be recalibrated .

14.5 Preparatory Blank (PB)/Laboratory Reagent Blank(LRB)

Acceptance Criteria - Analyze an LRB/PB per 20 samples or less per matrix. The PB/LRB results must be $<$ the |Reporting Limit|.

Corrective Action - If the result of the PB/LRB is $>$ |Reporting Limit|, then all associated samples with a concentration of $\leq 10\times$ the amount found in the PB/LRB should be

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reprepared and reanalyzed. If the samples cannot be reprepared, then all affected sample results must be either: qualified accordingly, or the Reporting Limit is raised to the amount found in the sample. Check with the team leader/section chief to determine which option should be used.

Sample results $\geq 10\times$ the amount found in the PB/LRB are not considered to be affected by the blank contamination or drift, so no corrective action is needed.

14.6 Laboratory Fortified Blank (LFB)/Laboratory Control Samples (LCS)

14.6.1 Aqueous LCS

Acceptance Criteria - Analyze two aqueous LFB/LCS samples with each batch of aqueous samples of 20 or less. Calculate accuracy as percent recovery using the following equation:

$$\% \text{ Recovery} = \frac{\text{Average of 2 LFB/LCS 's}}{s} \times 100$$

where: LFB/LCS = laboratory fortified blank/laboratory control sample

s = concentration of analytes added to fortify the LFB/LCS solution

The % recovery of the aqueous LFB/LCS must be within $\pm 15\%$ of the true value for NPDES wastewater compliance monitoring samples and within $\pm 20\%$ of the true value for all other environmental samples. The RPD of two LCSs should be $< 20\%$.

14.6.2 Solid LCS

Acceptance Criteria - Analyze two solid LCS samples with each batch of solid samples of 20 or less. Calculate accuracy as percent recovery using the following equation:

$$\% \text{ Recovery} = \frac{\text{Average of 2 LCS 's, mg/Kg}}{\text{True Value, mg/Kg}} \times 100$$

The % recovery of the solid LCS must be within $\pm 25\%$ of the true value or within the limits established by the vendor. The relative percent difference (RPD) of the duplicates should not exceed 25% for solid samples.

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Corrective Action for 14.6.1 and 14.6.2 - If the % recovery or %RPD results are outside the required control limits, the affected samples should be reprepared and reanalyzed. If the samples cannot be reprepared, then all affected sample results must be qualified accordingly.

14.7 Laboratory Fortified Matrix (LFM)/Matrix Spike(MS) Recovery

Acceptance Criteria - Fortify a known amount of analytes to one sample per matrix per project per batch of 20. The LFM/MS aliquot must be a duplicate of the aliquot used for sample analysis. When possible, the concentration should be the same as that added to the aqueous LFB/LCS, but should not exceed the midpoint concentration of the calibration curve. Calculate the percent recovery, corrected for background concentration measured in the unfortified sample aliquot, and compare these values to the control limits to the designated matrices recovery ranges : $\pm 20\%$ for aqueous samples; $\pm 25\%$ for solid samples (soils, sediment, and NAPL); and $\pm 50\%$ for sludge and biological tissue samples. Percent recovery is calculated using the following equation:

$$R = \frac{C_s - C}{s} \times 100$$

where:

R = percent recovery,

Cs = fortified sample concentration,

C = sample background concentration, and

s = conc. equivalent of metal added to sample.

Corrective Action - If % recovery of the MS is outside the required control limits, and the laboratory performance is shown to be in control, the recovery problem encountered is judged to be matrix related, not system related. The native sample result of the sample used to produce the MS must be qualified accordingly.

Note: The % recovery of the MS is not evaluated if the result of the unfortified sample concentration is $\geq 1.0 \times$ the level used to fortify the sample.

14.8 Serial Dilution Test

Acceptance Criteria - Analyze a 20% dilution of the MS sample(s). The serial diluted sample result(s), adjusted for the dilution, should agree with the MS result(s) to within 20% RPD.

Corrective Action - If the % RPD is outside the required control limits, and the

laboratory performance is shown to be in control, the precision problem encountered is judged to be matrix related, not system related, and the sample should be qualified accordingly.

14.9 Low-Level Checks - (ICV/50, ICV/20 and ICV/10)

Acceptance Criteria - Analyze the ICV/50, ICV/20 and ICV/10 standards, from a separate identifiable source other than the calibration standards, immediately following the ICV and ICB. The ICV/50, ICV/20 and ICV/10 should also be analyzed after every CCV. The % recovery of the ICV/50, ICV/20 and ICV/10 must be within $\pm 30\%$ of the true value for all analytes of interest.

Corrective Action - If the ICV/50, ICV/20 and ICV/10 cannot be verified within the specified limits, analysis must be evaluated, the cause determined and/or in the case of drift the instrument re-calibrated. If the ICV/50 and ICV/20 are not within the specified limits for the elements of interest but the ICV/10 is within the required limits, then the Reporting Limit is raised up to the ICV/10 level as long as the sample project requirement allows.

14.10 Spectral Interference Check (SIC)/Inter-Element Correction (IEC) Solution (formerly known as Interferents Only Solution - IOS)

Acceptance Criteria - All metal results (required by the project(s), except for Al, Fe, Ca, K, Mg, and Na, should be below the established Reporting Limits listed in Table 2

Corrective Action - If a required metal result is $>$ the |Reporting Limit|, the individual interferent metals must be analyzed independently to assess which metal is causing the interference. Once identified, the appropriate inter-element correction factor(s) and background correction point(s) must be reviewed, and where appropriate, adjusted. After the adjustment is completed, the IEC standard must be re-analyzed. Once a successful IEC is analyzed, the analysis can commence.

A corrective action is not required if one of the following conditions are met:

1. If the metal that is "affected" by the interferent is not required for the project(s) in question;
2. If the concentration of the metal that is "affected" by the interferent is $<$ the |Reporting Limit|;
3. If the concentration of the metal causing the interference in the "affected" environmental sample(s) is at a trace level, i.e., < 10000 ug/L (the level used in our mixed calibration standard, section 7.2.1).

14.11 Triplicate Integrations

Acceptance Criteria - Each analysis consists of three separate integrations or readings. This includes the calibration standards, quality control samples and all associated environmental samples. The average of the three measurements is used for reporting results. The RSD must be $\leq 20\%$ for all results that are \geq the reporting limit.

Corrective Action - If the RSD for a calibration standard, quality control sample and environmental sample is outside the control limits, the analysis must be repeated. If the RSD is still outside the control limits, the analysis must be terminated, and repeated after correcting the problem. If the RSD is still outside the control limits, and the laboratory performance, i. e. CCV, is shown to be in control, the RSD problem encountered is judged to be matrix related, not system related, and the sample should be qualified accordingly.

15. Reporting and Validation

15.1 Reporting Limits - The reporting limits are calculated based on the concentration of the lowest calibration standard analyzed. The reporting limits are matrix and dilution dependent. All results are reported to 2 significant figures.

15.2 Sample Data Package

The sample data package should include but not be limited to the following:

- ICAP-AES QA/QC Checklist with all relevant information entered;
- Copies of Log Book entries of Analysis Run Log; Sample Digestion Log, and if required, Sample Percent Solids Log and/or pH Log;
- Calibration Report;
- Summary Analysis Form;
- QC Summary Forms; and
- Instrument generated Sample Data

15.3 Laboratory Information Management System (LIMS) - The analyst enters the data on the LIMS under the appropriate analytical codes.

15.4 Data Validation - The data package is given to the reviewer. The review is done by a peer who was not involved in the analysis. Upon completion of the review, including validation of all the appropriate codes in the LIMS for the particular project(s), the data reviewer will sign and date the QA/QC Checklist.

15.5 Data Records - All project records associated with the data package are filed under one designated project file. All other projects associated with the data package are

referenced to this designated project file via a "cross reference form". The "cross reference form" is placed in each of the project files that were associated with the data package.

The data package is placed in the bin identified for the designated project file. The records for this designated project file are filed in our locked record cabinets once all data from the project, e.g., non-metal inorganic data, organic data, microbiology data, etc. has been reviewed by the appropriate staff.

16. Pollution Prevention

- 16.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.
- 16.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.
- 16.3 For information about pollution prevention that may be applicable to laboratories and research institutions, consult *Less is Better: Laboratory Chemical and Management for Waste Reduction*, available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington D.C. 20036, (202)872-4477.

17. Waste Management

The USEPA requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process waste should be characterized and disposed of in an acceptable manner. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For

further information on waste management consult the Region 2 SOP G-6, "*Disposal of Samples and Hazardous Wastes*".

18. REFERENCES

- U. S. Environmental Protection Agency. "*Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry*," Method 200.7, Revision 4.4, May 1994.
- U. S. Environmental Protection Agency, Region 2, SOP G-6 "*Disposal of Samples and Hazardous Wastes*."
- U. S. Environmental Protection Agency, Region 2, SOP G-8 "*Laboratory Policy for the Determination of Method Detection Limits (MDLs)*."
- U. S. Environmental Protection Agency, Region 2, SOP G-15 "*Laboratory Definitions and Data Qualifiers*."
- U. S. Environmental Protection Agency, Region 2, SOP G-23 "*Percent Dry Solids*."
- U. S. Environmental Protection Agency, Region 2, SOP C-116 "*Preparation of Aqueous, TCLP Extracts, Soil/Sediment/Sludge, Waste Oil/Organic Solvents, and Biological Tissue Matrices by Block Digestion*."
- Method 2340 B "*Hardness by Calculation*"_Standard Methods for the Examination of Water and Wastewater, 20th Edition-1998.
- U. S. Environmental Protection Agency, Solid Waste 846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 6010C "*Inductively Coupled Plasma - Atomic Emission Spectrometry*" Laboratory Manual, Revision 3, November 2000.

APPENDIX A

DATA WORKUP

- Copy data database (e.g., 121604.dbf) and the sample data file (samples.dbf) to a rewritable CD. The file nomenclature is based on the date of analysis, e.g., 121604.dbf - 12 is month of December, 16 is the date and 04 is the year 2004.
- Login to LABWORKS
- Select Results from the main menu
- Select Instrument Conversion
- Select file name by recalling the data file, e.g., 121604.dbf
- Click OK. After OK is clicked a file is created converting the samples to .grf files
- Upload the correct .grf file into each individual sample by selecting the sample number with the corresponding test codes in the project.
- Right click on the results cell
- Select Modify Results
- Select Load Results
- Select the correct file from L:\Labwork_ES\LWDATA5\INTRFACE\TJA_DBF drive
- Click OK
- Check results to ensure that they are correct
- Delete any test codes in the project LIMS codes that are not required
- Make sure the reporting limits reflect analytical and prep dilutions, if any.

Table 1. Standard Solutions Preparation:

Standard/Solution Name	Concentration Required
Std 1 - Calibration Blank/ ICB/Rinse Blank/CCB	Reagent grade water
Std 2	1000 ppb all elements except 10,000 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/CCV	200 ppb for all elements except 5000 ppb Al, Ca, Fe, Mg, K, Na and Si
ICV/50	4 ppb all elements except 100 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/20	10 ppb all elements except 250 ppb for Al, Ca, Fe, Mg, K, Na and Si
ICV/10	20 ppb all elements except 500 ppb for Al, Ca, Fe, Mg, K, Na and Si
IEC Solution (previously known as IOS)	300,000 ppb Al, Ca, Fe, Mg and 60,000 ppb Na
Profile Solution	5,000 ppb As
Internal Standard	2,000,000 ppb Li 10,000 ppb Y

Note : The diluent used in preparing all the above standard solutions must be reagent grade water with 2% HNO₃ and 5% HCl.

Table 2. Reporting Limits - Aqueous and Soil/Sediment

Element	MDL, ug/L	Reporting Limit, ug/L	Reporting Limit, mg/Kg
Ag	1.6	6	0.6
Al	48.5	200	200
As	2.3	8	0.8
B	2.3	8	0.8
Ba	1.6	6	0.6
Be	1.5	5	0.5
Ca 396.8	51.1	1000	100
Ca 317.9	51.4	1000	100
Cd	1.3	4	0.4
Co	2.3	8	0.8
Cr	1.8	6	0.6
Cu	2.7	10	1
Fe 259.9	42.5	200	20
Fe 271.4	55	200	20
K	126.0	1000	100
Mg 285.2	47.0	1000	100
Mg 279.0	54.8	1000	100
Mn	1.4	5	0.5
Mo	2.1	8	0.8
Na	589.0	1000	100
Ni	1.4	5	0.5
Pb	2.1	7	0.7
Se	1.9	7	0.7
Sb	3.7	14	1.4
Si	81.4	300	30
Sn	2.5	9	0.9
Sr	1.7	6.0	0.6
Ti	2.2	8	0.8
Tl	5.5	20	2
V	2.7	10	1
Zn	2.2	8	0.8

- Notes:
- 1) The IDL results were obtained using the analysis of seven ICV/40 standards analyzed on separate days
 - 2) The IDLs for all elements, except K and Si, were obtained by multiplying the standard deviation of the seven analysis by 3.14
 - 3) The Reporting Limits were obtained by multiplying the IDLs by 3.6 (1.2x3) and rounding to 2 significant figures



STANDARD OPERATING PROCEDURE

PREPARATION OF AQUEOUS, TCLP EXTRACTS, SOIL/SEDIMENT/SLUDGE/SOLID, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE MATRICES BY BLOCK DIGESTION

Signature and Title

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Approved by:	_____ John R. Bourbon, Chief, OICS	_____ Date
Approved by:	_____ Deborah A. Szaro, Chief, Laboratory Branch	_____ Date

Annual Review

Reviewed by:	_____ Signature	_____ Date
Reviewed by:	_____ Signature	_____ Date

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STANDARD OPERATING PROCEDURE

PREPARATION OF AQUEOUS, TCLP EXTRACTS, SOIL/SEDIMENT/SLUDGE, WASTE OIL/ORGANIC SOLVENTS, AND BIOLOGICAL TISSUE MATRICES BY BLOCK DIGESTION

1. Scope and Application

- 1.1 This method is used to digest by DigiBLOC, all environmental samples, with the exception of drinking water. These include aqueous, TCLP extracts, soil/sediment/sludge/solid, waste oil/organic solvent, and biological tissue. Samples are then analyzed using ICP-AES, SOP #C109 or ICP-MS, SOP # C-112.
- 1.2 This SOP is based on EPA Methods 200.2, Revision 8.8 and EPA Method 200.8, Revision 5.4.

2. Summary of Method

- 2.1 Aqueous or Aqueous TCLP: A suitable aliquot (usually 50 mL) of a well mixed, aqueous or homogeneous extract sample is accurately measured into a DigiTUBE and heated on the DigiBLOC at 85° C with HNO₃ and HCL until the volume is reduced to 20mL. A watch glass is then placed on the tube and the sample is gently refluxed for an additional 30 minutes. After cooling, the sample is brought up to a known volume, capped and mixed. If needed, the digestates may be filtered.
- 2.2 Soil/Sediment/Sludge/Solid: Samples may be dried for a minimum of 12 hours at 60°C, ground well and mixed thoroughly or the drying step may be eliminated by digesting the samples as they are received. A correction factor derived from a Percent Solids determination is applied to the final result for either method. An aliquot is accurately weighed into a DigiTUBE and digested with HNO₃ and HCL at 95° C for 30 minutes. After cooling, the sample is filtered and brought up to a known volume, capped and mixed.
- 2.3 For biological tissue digestion, the sample is accurately weighed into a DigiTUBE and digested with HNO₃ and 30% H₂O₂.
- 2.4 Samples are then analyzed using ICP-AES or ICP-MS. In all instances, great care must be exercised to avoid contamination.

3. Definitions

See SOP#G-15 for definitions.

4. Interferences

Samples must be well mixed and as homogenous as possible. Soil/Sediments/Sludges/Solids must be reduced to as small a particle size as practicable.

5. Safety

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be kept to an absolute minimum by following the appropriate standard safety procedures, e.g. wear proper protective equipment, gloves, lab coat, and working inside hoods whenever possible. Refer to Edison Facility Safety Manual Region II, Part 2 - Laboratory Safety for specific guidelines.

5.2 Safety guidelines for the DigiBLOC

5.2.1 The DigiBLOC must be grounded and have a clearance of 3 inches on all sides. It must be located in an operable fume hood if the DigiVAC is not available. Do not mount DigiBLOC on a surface of flammable material.

5.2.2 The DigiBLOC must be lifted only from the bottom, not by the top white trim. Acquire assistance to move the unit.

5.2.3 Use caution when working around the instrument during operation. The unit has exposed hot surfaces.

6. Apparatus and Materials

6.1 DigiBLOC Digestion System consisting of the Hot Block, with two 24 Position Racks with front and back airfoils,

6.2 DigiPROBE Sample Temperature Controller and probe.

6.3 DigiSET Sample Volume Controller and volume probe.

6.4 DigiVAC Exhaust System

- 6.5 50 mL DigiTUBEs, screw caps and disposable ribbed watch glasses.
- 6.6 Top loading balance capable of measuring 0.01 gram, disposable spatulas and small weighing dishes for soil/sediment/sludge/solid digestion.
- 6.7 Porcelain evaporating dishes (195mL), pestles and glass stirring rods for soil/sediment/sludge/solid digestion.
- 6.8 Two re-pipettes capable of dispensing 0.25-5.0mL.
- 6.9 Two automatic pipettes (1-250uL & 1-1000uL).
- 6.10 Whatman #41 filter paper - 125mm.
- 6.11 Disposable polypropylene funnels (65mm) and 100mL disposable beakers.
- 6.12 Filtration rack

7. Reagents and Solutions

All reagents must be of high purity and suitable for trace metal analysis.

- 7.1 Concentrated Nitric Acid (HNO₃)
- 7.2 Ultrex Concentrated Nitric Acid (HNO₃)
- 7.3 Concentrated Hydrochloric Acid (37%)
- 7.4 Hydrogen Peroxide, 30%
- 7.5 Reagent Grade Water
- 7.6 SPEX CertiPrep Custom Claritas Standard High Check containing 250ug/mL (250ppm) of each of the following: Ag, Al, As, B, Ba Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Se, Sb, Si, Sr, Ti, Tl, V, Zn, Sn or equivalent.
- 7.7 SPEX CertiPrep Custom Multi-element Standard ICV II containing 250mg/l (250 ppm) of each of the following: Al, Ca, Fe, Mg, K, Na, Si or equivalent.
- 7.8 Soil LCS - Environmental Resource Associates: Trace Metals in Soil or equivalent.

- 7.9 Biological Tissue LCS - DOLT-3 National Research Council, Canada, Tort-2 National Research Council, Canada, NIST 15666 - Oyster Tissue or other suitable material.

8. Sample Collection, Preservation, Storage and Holding Time

- 8.1 Aqueous: Samples may be collected in plastic or glass. Samples must be preserved to a pH<2 using HNO₃, may be stored at room temperature and should be digested and analyzed within 6 months of collection.
- 8.2 Soil/Sediment/Sludge/Solid: Samples may be collected in plastic or glass. Samples must be stored at 4° C and should be digested and analyzed within 6 months of collection unless stored at -20° C after air-drying.
- 8.3 Biological Tissue: Samples may be collected in plastic or glass containers and must be stored at -20°C.
- 8.4 Waste Oil/Organic Solvents: Samples do not require any preservation and are stored at room temperature.
- 8.5 Drum sample usually have no temperature or holding time requirements.

9. Sample Preparation

9.1 Aqueous Sample Preparation

- 9.1.1 Verify that the pH of the sample is <2 using pH test paper. Record in the Metals Sample pH log book. If the pH is >2, add concentrated HNO₃ until the pH is <2, then wait at least 16 hours before rechecking the pH and proceeding with the sample prep.
- 9.1.2 Transfer 50mL (or other suitable aliquot) from a well mixed, acid preserved sample to a 50mL DigiTUBE. In addition, prepare a Prep Blank, two LCS's and 1 matrix spike for each project/matrix with at least one matrix spike per batch of 20 or fewer samples. Also prepare extra blank sample tubes that will hold the DigiPROBE and, if used, the DigiSET volume control probe. Refer to Section 14.1 of this SOP for QC procedure.
- 9.1.3 Add 0.5 mL concentrated nitric acid and 0.25mL of concentrated hydrochloric acid to each tube.

- 9.1.4 Insert the tubes into the DigiBLOC for solution evaporation at a pre-tuned temperature of 85 °C. If space permits, leave the outer rows empty. Position the extra blank samples under the exhaust hole of the DigiVAC. Carefully position the DigiPROBE in one tube and the DigiSET volume control set to 20mL in the other tube. If the DigiVAC is unavailable, carefully place the instrument in a hood and proceed. If the DigiSET is not used, monitor volume visually.
- 9.1.5 Close the DigiVAC lid and turn power on to the DigiVAC, DigiSET and DigiBLOC.
- 9.1.6 Reduce volume to approximately 20 mL by gently heating at 85°C then cap each tube with a disposable ribbed watch glass and reflux for 30 minutes.
- 9.1.7 Remove from DigiBLOC. Allow to cool. Filter, if necessary. (See Section 9.2.7) Dilute to 50 mL with Reagent Grade water, cap and mix well.

9.2 Soil/ Sediment/Sludge/Solid Preparation

9.2.1 Sample Drying

9.2.1.2 Pre-Drying Method

This method works best for samples that have a high water content. Evaporating dishes and pestles must be rinsed with 10% HNO₃.

Transfer the sample to a 195mL porcelain evaporating dish using a glass stirring rod or disposable spatula and dry at 60°C for a minimum of 12 hours. Cool, then grind with a pestle in the porcelain evaporating dish. Mix well, transfer to a plastic or glass container and store at 4°C until ready to digest.

These sediment samples require a % Solids determination. See the METALS % SOLIDS LOGBOOK for procedure. % Solids results are reported under SOLA in LIMS. This does not preclude an analysis request for % Solids.

9.2.1.2 "As Received" Method

This method works best for samples that have a low water content. Samples are digested as received. A % Solids determination is performed using the procedure described in the METALS % SOLIDS LOGBOOK. % Solids results are reported under SOLA in LIMS. This does not preclude an analysis request

for % Solids.

- 9.2.2 Weigh 0.5g or other suitable aliquot of well mixed sample into a 50 mL DigiTUBE. Use approximately 5mL of Reagent Grade water to rinse down the sides of the DigiTUBE. In addition, prepare a Prep Blank, two LCS's, 1 matrix spike for each project/matrix with at least one matrix spike per batch of 20 or fewer samples and an extra sample that will hold the DigiPROBE. Refer to Section 14.2 for QC prep.
- 9.2.3 Under a fume hood, add 5 mL Reagent Grade water, 1.0mL conc. HNO₃ and 1.0mL of conc. HCL to the tubes. Keep samples under the hood until any reaction subsides.
- 9.2.4 Insert the tubes into the DigiBLOC for digestion at a pre-tuned temperature of 95°C. If space permits, leave the outer rows empty. In the extra sample tube, using a disposable watch glass with a hole, carefully position the DigiPROBE. This digestion may also be carried out using the DigiVAC.
- 9.2.5 Place a disposable watch glass on each tube and turn on the power to the DigiBLOC. If being used, close the DigiVAC lid and turn the power on to the DigiVAC
- 9.2.6 Heat samples at 95°C for 30 minutes. The DigiBLOC takes about 30 minutes to heat up to temperature.
- 9.2.7 Filtration is required for soil/ sediment/sludge/solid samples. Label a duplicate set of DigiTUBES. Rinse Whatman #41 filter paper in disposable funnels with approximately 10mL Reagent Grade water. Place rinsed funnels into duplicate DigiTUBES and transfer corresponding sample. Rinse original tube several times with Reagent Grade water. Dilute to 50mL with Reagent Grade water, cap and mix well.

9.3 Biological Tissue Digestion

- 9.3.1 Homogenize the samples. Store samples in the freezer if digestion is delayed, then defrost prior to preparation for digestion. All determinations, including the LCS and matrix spike must be done in triplicate. Refer to Section 14.3 of this SOP for QC prep.
- 9.3.2 Weigh 2.0 g finely ground and well mixed sample or 1.0 g LCS (Dolt-3, Tort-2 or NIST 15666 Oyster Tissue) into a 50 mL DigiBLOC tube. Record actual weights

in Prep Book. Be careful not to let tissue stick to sides of tube - aim for the bottom of tube. Prepare three tubes for the Prep Blanks and weigh an additional tissue sample for the DigiPROBE.

- 9.3.3 Add 5 mL concentrated Ultrex HNO_3 and swirl to mix. Heat gently in the DigiBLOC (tuned to 95°C) with continued swirling. If samples begin to foam, remove from heat until foam subsides. Continue to heat/cool and swirl until samples no longer foam, then digest at 95°C until sample appears clear. A 2 g sample should be clear after about 15 minutes of digestion.
- 9.3.4 Foaming is a more serious problem with the LCS. Dolt -3 will foam copiously when warmed with HNO_3 . Extreme care is needed in swirling and gently heating until the LCS/ HNO_3 mixture appears clear. Then allow to digest at 95°C in the DigiBLOC for an additional 15 minutes.
- 9.4.5 After digestion with HNO_3 is completed, add 0.5 mL 30% H_2O_2 in 0.1 mL portions to each of the tubes, swirling and heating with each addition until any effervescence subsides. It then should be safe to add 0.5 mL portions of the H_2O_2 , heating in between additions until the samples become totally clear. After samples are totally clear, add 1 mL additional H_2O_2 , cover the tubes with a plastic watch glass and digest for 30 minutes more. Remove from the DigiBLOC, cool and dilute to 20 mL with Reagent Grade water. Cap securely and mix well.

10. Instrument Operating Conditions

10.1 DigiBLOC set-up

10.1.1 Power ON - Power switch.

- 10.1.2 Check Temperature Set-Point by pressing the star button (*). Temperature should be set at 85°C for Aqueous and TCLP extracts, 95°C for soil/sediment/sludge/solid, waste oil/organic solvent and biological tissue. If the temperature must be changed or the DigiPROBE is either connected or disconnected, the instrument must be tuned.

- 10.1.2.1 Set temperature by pressing and holding the star button (*) while simultaneously pressing the \blacktriangle (arrow up) or the \blacktriangledown (arrow down) button to obtain the desired temperature.

- 10.1.2.2 Tune DigiBLOC as follows:

- Set desired temperature.
- Hold the ▲(arrow up) and ▼(arrow down) keys simultaneously for ≈ 3 seconds to enter program mode. The display will show *tunE*.
- While holding the star button(*), hit the ▲(arrow up) to reach *AESP* (*the E is actually an upside down F*) and then release the star button (*).
- Press and hold buttons simultaneously for 3 seconds until the temperature appears. The system will flash between *tunE*, *AESP* and the current temperature.
- When tuning is complete, the system will automatically turn *tunE* off and display the current temperature only.

10.2 DigiBLOC Shut-down

10.2.1 Power OFF - DigiBLOC and DigiVAC if used

10.2.2 Rinse DigiPROBE with Reagent Grade water and place in a clean empty tube.

11. Sample Analysis

Actual sample analysis is carried out using methods SOP #C-109 Trace Metals in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent, Biological Tissue- ICP-AES or SOP #C-112 Trace Elements in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent and Biological Tissue by ICP-MS.

12. Data Analysis and Calculations

Calculations are not done as part of this method. All weights and dilutions are recorded in the Metals Sample Prep Log Book

13. Method Performance

Method performance is evaluated as part of methods SOP #C-109 Trace Metals in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent, Tissue - ICP-AES or SOP #C-112 Trace Elements in Aqueous, Soil/Sediment/Sludge/Solid, Waste Oil, Organic Solvent and Biological Tissue by ICP-MS.

14. Quality Control

14.1 Aqueous Quality Control

- 14.1.1 One Prep Blank (PB) should be prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 50mL of Reagent Grade water into a 50mL DigiTUBE and adding 0.5mL HNO₃ and 0.25mL HCl.
- 14.1.2 Two LCS's (Laboratory Control Samples) are prepared for every batch of 20 or fewer samples. These LCS's are made by pipetting 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CertiPrep Custom Multi-element Standard ICV II (250PPM) into 50mL DigiTUBEs containing 50 mL Reagent Grade water, 0.5mL of concentrated HNO₃ and 0.25mL concentrated HCl.
- 14.1.3 One Matrix Spike (MS) is prepared for each matrix per project with at least one MS per batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CERTIPREP Custom Multi-element Standard ICV II (250PPM) to a DigiTUBE containing 50 mL of a duplicate environmental sample, 0.5mL of concentrated HNO₃ and 0.25mL concentrated HCl.

14.2 Sediment Quality Control

- 14.2.1 One Prep Blank should be prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 5mL of Reagent Grade water into a 50mL DigiTUBE and adding 1.0mL HNO₃ and 1.0mL HCl.
- 14.2.2 Two LCS's are prepared for every batch of 20 or fewer samples. These LCS's are made by weighing 0.5g of ERA's Trace Metals in Soil into a 50mL DigiTUBEs and adding 5mL of Reagent Grade water to wash down the sides of the tube, 1.0mL HNO₃ and 1.0mL HCl.
- 14.2.3 One Matrix Spike is prepared for each matrix per project with at least one MS per batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CERTIPREP Custom Multi-element Standard ICV II (250PPM) to a 50mL DigiTUBE containing 0.5g of a duplicate environmental sample, 5mL of Reagent Grade water, 1.0mL HNO₃ and 1.0mL HCl.

14.3 Biological Tissue Quality Control

- 14.3.1 Three Prep Blanks are prepared for every batch of 20 or fewer samples. The PB is prepared by transferring 5mL of conc. HNO₃ and 5 mL 30% H₂O₂ into a 50mL DigiTUBE and digesting at 95°C for about 45 minutes, then diluting to 20mL with Reagent Grade water.
- 14.3.2 The LCS is prepared in triplicate for every batch of 20 or fewer samples. DOLT-3 is presently being used for the LCS, but Tort-2 , NIST 15666 Oyster Tissue or other suitable material are also acceptable. Digest as directed in 7.4.
- 14.3.3 The Matrix Spike (MS) is prepared in triplicate for each matrix per project for each batch of 20 or fewer samples. The MS is prepared by adding 20uL of (CAL I) SPEX CertiPrep Custom Claritas Standard (250PPM) and 400uL of SPEX CertiPrep Custom Multi-element Standard ICV II (250PPM) to a DigiTUBE containing 2.0g of a duplicate biological tissue sample and digesting as directed in 7.4.

15. Reporting and Validation

Copies of all Log Book entries (pH, Sample Preparation, Percent Solids) are included in the final data packages.

16. Pollution Prevention

- 16.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the USEPA recommends recycling as the next best option.
- 16.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.
- 16.3 For information about pollution prevention that may be applicable to laboratories, consult *"Less is Better: Laboratory Chemical Management for Waste Reduction"*, available from the American Chemical Society's Department of Government

Regulations and Science Policy, 115 16th Street N.W., Washington D.C 20036,
(202)872-4477.

17. Waste Management

The USEPA requires that laboratory waste management practice be conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes should be characterized and disposed of in an acceptable manner. The agency urges laboratories to protect the air, water and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any water discharge permit and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management consult the Region 2 SOP #G-6, "Disposal of Samples and Hazardous Wastes".

18. References

1. EPA Method 200.2, Revision 2.8.
2. SW846 3010A
3. Operation Manual for DigiBLOC 3000 Digestion System
4. DigiVAC Operation Manual

APPENDIX D

HISTORICAL ARSENIC DATA RESULTS (YEAR 1992 AND YEARS 1994 THROUGH 1999)


(USEPA/ERTC 1999)

FINAL REPORT
Vineland Chemical Site
Field Investigation
Vineland, Cumberland County, NJ
May 1999

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1.0 INTRODUCTION

1.1 Objective

The objective of this study was to collect sediment, soil and water data to assess the public health hazard for arsenic contamination at three beaches along the Maurice River, two beaches along Union Lake, a potable water well at the Union Lake Sailing and Tennis Club, and potable water wells at two houses adjacent to the Vineland Chemical site. The data was evaluated against human health risk based action levels. This study was part of an annual monitoring program performed at beaches along the Maurice River and Union Lake.

1.2 Site Background

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles, a practice that has since been discontinued. This resulted in soil and groundwater contamination in the vicinity of the site. In addition, runoff during storm events and recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including the Blackwater Branch, Maurice River, and Union Lake. Arsenic-contaminated groundwater, process water, non-contact cooling water, and storm water runoff are currently treated on site. Effluent containing approximately 0.7 milligrams per liter (mg/L) arsenic is discharged from the wastewater treatment facility to an unlined lagoon where it percolates into the ground.

Previous studies have investigated the extent and magnitude of arsenic contamination in the Maurice River watershed (Faust et al. 1983, Weston 1988). Data available concerning arsenic contamination indicates that both the water and sediment are contaminated downstream of the site. The maximum arsenic concentrations detected in surface water, sediment and interstitial water were 2,780 micrograms per Liter ($\mu\text{g/L}$), 14,000 milligrams per kilogram (mg/kg) and 12.5 mg/L, respectively. The New Jersey Department of Environmental Protection (NJ DEP) and the United States Environmental Protection Agency (U.S. EPA) standards for arsenic in drinking water are 0.05 mg arsenic/L (U.S. EPA 1993). The extent of arsenic contamination ranges from the Blackwater Branch in the vicinity of the Vineland Chemical facility to a point approximately 26.5 miles downstream from the site.

Sediment, soil and surface water samples were collected at four beaches downstream of the site as part of an annual monitoring program (Weston 1992, 1995a, 1995b, 1996, 1997, 1998). In addition, potable water samples were collected from a well downstream of the site in 1996 and 1997. In 1998, additional potable water samples were collected at two houses adjacent to the Vineland Chemical property. Arsenic was not detected in any of the well samples.

In May 1999, the U.S. EPA Region II requested that the U.S. EPA/Environmental Response Team Center (ERTC) collect sediment, soil and water samples from three beaches along the Maurice River, two beaches at Union Lake, and potable water samples from the Union Lake Sailing and Tennis Club and from two houses adjacent to the site.

2.0 METHODOLOGY

2.1 Field Sampling Design

The sampling was conducted to assess the potential human exposure to arsenic and should not be interpreted as a comprehensive extent of contamination. The specific sampling locations were

determined by the U.S. EPA Region II Remedial Project Manager (RPM), Matthew Westgate (Figure 1). On 29 April 1999, two sediment, one soil and one disturbed water sample were collected at each of the five previously sampled beaches. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use. Potable water samples were collected from Union Lake Sailing and Tennis Club and from two houses adjacent to the site. The eight locations sampled were as follows:

Sampling Location	Description of Sampling Location
Alliance Beach	Upstream of Almond Beach, unmaintained public day-use area.
Almond Beach	Publicly maintained beach area approximately 100-150 feet long.
BA Beach	Downstream of Almond Beach, consisting of an unmaintained public day-use area.
Union Lake Beach	Privately maintained beach, downstream of the site.
Union Lakes Sailing and Tennis Club	Privately maintained club, downstream of the site, potable water well.
South End of Union Lake Beach	Publicly maintained beach at the southern end of Union Lake.
House #1	1618 Wheat Rd., across from the site.
House #2	1509 Wheat Rd., adjacent to the site.

→ All beach sampling areas were characterized by shallow depth (less than three feet), gradual slope and sluggish flow. The sediment was sandy near the shore with coarser sand and small to medium gravel in deeper areas. Thin deposits of black silt were evident at depositional areas along the bottom.

A Horiba U-10@ Water Quality Monitoring Instrument was used at each sample location to measure temperature, pH, dissolved oxygen, conductivity, and salinity. The Horiba U-10@ was operated according to the manufacturer's operating manual.

2.2 Sediment, Soil and Water Sampling

Two sediment samples were collected from each of the five beaches sampled using a decontaminated Ponar dredge according to ERTC/REAC SOP #2016, *Sediment Sampling*. One sediment sample was collected upstream of the beach and one downstream of the beach. Sediment was collected from depositional areas where there was evidence of black silt. The dredge contents were composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface soil samples (0-4 inches below ground surface) were collected from each beach area using plastic trowels according to ERTC/REAC SOP #2012, *Soil Sampling*. The soil sample was composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface water samples were collected as per modification of ERTC/REAC SOP #2013, *Water Sampling*. The modification included collecting samples directly into a 1-L polyethylene bottle while

Submerged
bottle

disturbing the adjacent sediments. The samples were collected at a depth of 6 to 12 inches below the surface and approximately 6 inches above the bottom. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use.

The potable water samples were collected according to ERTC/REAC SOP #2051, *Potable Water Sampling*. All water samples were preserved after collection using 40 percent nitric acid to a pH of less than 2.

After each sample was collected, the labeled sample jars were placed in a resealable plastic bag and stored in a sample cooler on wet ice [4 degrees Celsius ($^{\circ}\text{C}$)]. Field documentation (field logbook notes, and chain of custody forms) are located in Appendix A. The samples were delivered to the REAC Inorganic Laboratory in Edison, New Jersey, on 29 April 1999. The final analytical results are located in Appendix B.

3.0 RESULTS

3.1 Sediment Samples

Arsenic was detected in all sediment samples at concentrations ranging from 1.7 to 11 mg/kg (Table 1). The maximum concentration of arsenic (11 mg/kg) was detected in the upstream sample from the South end of Union Lake and the minimum concentration of arsenic (1.7 mg/kg) was detected in the downstream sample from BA Beach. Sediment grain size was qualitatively characterized as containing predominantly large grain sizes such as sand and small to medium gravel. Sediment collected from all five beaches contained a fine layer of highly suspendible silt.

3.2 Soil Samples

Arsenic was detected in three of the five beach soil samples at concentrations ranging from 0.43 to 2.6 mg/kg (Table 1). The maximum concentration of arsenic (2.6 mg/kg) was detected at Union Lake and the minimum concentration of arsenic (0.43 mg/kg) was detected at Almond Beach. Arsenic was not detected at BA Beach and at South End of Union Lake Beach above the method detection limit (MDL) of 0.41 mg/kg. The soil at all five locations consisted primarily of sand and some small gravel.

3.3 Water Samples

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 to 0.24 mg/L (Table 2). The maximum concentration of arsenic (0.24 mg/L) was detected at Alliance Beach and the minimum concentration of arsenic (0.006 mg/L) was detected at Union Lake. Arsenic was not detected (MDL = 0.002 mg/L) in Union Lake Sailing and Tennis Club, House #1 and House #2 potable water samples.

3.4 In-Situ Water Quality

In-situ water quality parameters were consistent at all locations (Table 3). Temperature ranged from 13.2 to 16.9 $^{\circ}\text{C}$ and dissolved oxygen ranged from 8.66 to 11.5 mg/L. The pH ranged from 5.7 to 8.69 standard units. Conductivity ranged from 0.061 to 0.095 millimhos per centimeter (mmhos/cm). Salinity was measured at zero parts per thousand (ppt) at all locations.

3.5 Field Blanks

Arsenic was not detected at concentrations above the MDL (0.002 mg/L for water and 0.48 mg/kg for soil and sediment) in any field blanks. As such, it is unlikely that any contamination can be attributed to improper sample collection and handling.

4.0 DISCUSSION AND SUMMARY

Arsenic was detected in sediment samples collected at all locations at concentrations ranging from 1.7 to 11 mg/kg. The sediment in the Maurice River and Union Lake contains a high content of organic matter. Arsenic is typically adsorbed to the organic portion of sediment (Eisler 1988). Therefore, the arsenic may have been bound to the fine organic matter that was observed in the sediment.

Arsenic was detected in three of the five soil samples collected at concentrations ranging from 0.43 to 2.6 mg/kg. The soil samples were composed of coarse sand and some small gravel with very little organic matter. Arsenic typically binds to the organic matter in soil (Eisler 1988). The lack of organic matter in these samples implies a lack of adequate binding sites for arsenic. Therefore, rain or other inputs may cause the leaching of arsenic out of the soil and may account for the low concentrations of arsenic in these soil samples.

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 mg/L to 0.24 mg/L. Arsenic concentrations were above the U.S. EPA drinking water standard of 0.05 mg/L (U.S. EPA 1993) at two of the five beaches sampled (Alliance Beach and Almond Beach). Water samples were collected while disturbing the sediments so that particles of the highly suspendible fine silt layer were incorporated in the sample. Arsenic detection may be attributed to the organic fraction of the disturbed sediments present in the water samples. Riedel *et al.* (1988) found that the predominate component of detectable arsenic in water is associated with the sediment solids. Arsenic was not detected (MDL = 0.002 mg/L) in the potable well water samples taken at the Union Lake Sailing and Tennis Club, House #1 or House #2.

Concentrations of arsenic in the surface water collected from the Maurice River tended to be higher than the concentrations in surface water collected from Union Lake, with the exception of the BA Beach sample. Several reasons for this appear to exist. First, the Maurice River is directly downstream of the point-source of contamination and flows into Union Lake. Second, other tributaries flowing into Union Lake may cause the dilution of arsenic concentrations detected at these locations.

There are a number of factors that affect arsenic concentrations, including storm events, groundwater flow, flooding, grain size and sampling technique. Historic data for sediment, soil and water were compiled in Table 4 and Figures 2-4. No trends are discernable in the data as the concentration of arsenic in all matrices have remained relatively constant over time.

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Table 1. Results of the Arsenic Analysis in Soil/Sediment
 Vineland Chemical Site
 Vineland, Cumberland County, New Jersey
 May 1999

(Results reported in mg/kg)

Sample ID	Matrix	Location	Conc	MDL
A19255	Soil	Alliance Beach	0.59	0.41
A19256	Sediment upstream	Alliance-U	10	0.42
A19257	Sediment downstream	Alliance-D	3.4	0.41
A19251	Soil	Almond Beach	0.43	0.39
A19252	Sediment upstream	Almond-U	3.4	0.44
A19253	Sediment downstream	Almond-D	1.9	0.41
A19259	Soil	BA Beach	U	0.47
A19260	Sediment upstream	BA-U	6.6	0.41
A19261	Sediment downstream	BA-D	1.7	0.44
A19267	Soil	Union Lake	2.6	0.41
A19268	Sediment upstream	Union Lake-U	6.0	0.47
A19269	Sediment downstream	Union Lake-D	2.8	0.42
A19263	Soil	So. End Union Lake	U	0.48
A19264	Sediment upstream	So. End Union Lake-U	11	0.38
A19265	Sediment downstream	So. End Union Lake-D	5.1	0.42

MDL - method detection limit

U - not detected

mg/kg - milligram per kilogram

Table 2. Results of the Arsenic Analysis in Water
 Vineland Chemical Site
 Vineland, Cumberland County, New Jersey
 May 1999

(Results reported in mg/L)

Sample ID	Location	Conc.	MDL
A19258	Alliance Beach	0.24	0.002
A19254	Almond Beach	0.11	0.002
A19262	BA Beach	0.01	0.002
A19270	Union Lake	0.006	0.002
A19271	Union Lake Yacht Club House	U	0.002
A19266	South End Beach, Union Lake	0.02	0.002
A19272	House #1	U	0.002
A19273	House #2	U	0.002

MDL - method detection limit

U - not detected

mg/L - milligrams per Liter

**Table 3. In-Situ Water Quality Parameters
Vineland Chemical Site
Vineland, New Jersey
May 1999**

Location	Temperature (C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mmhos/cm)	Salinity (ppt)
Alliance Beach	15.1	8.91	6.30	0.079	0.00
Almond Beach	13.5	8.66	6.40	0.077	0.00
B-A Beach	14.6	9.65	5.83	0.079	0.00
Union Lake	16.9	9.65	5.70	0.091	0.00
Union Lake Yacht Club	14.8	11.50	7.00	0.061	0.00
So. End Union Lake	15.3	9.40	5.90	0.093	0.00
House #1	14.0	11.30	6.10	0.095	0.00
House #2	13.2	11.24	8.69	0.085	0.00

C - degrees Celsius

mg/L - milligrams of dissolved oxygen per liter of water

mmhos/cm - micromhos per centimeter

NTU - nephelometric turbidity units

ppt - parts per thousand

Table 4. Concentrations of Arsenic in Sediment, Soil and Water from 1992-1999
 Vineland Chemical Site
 Vineland, New Jersey
 May 1999

Year Sampled	Matrix	Units	Alliance Beach	Almond Beach	BA Beach	Union Lake Beach	South End Union Lake Beach
1992	Water	(mg/L)	0.52	0.15	0.036	NS	NS
	Soil	(mg/kg)	NS	NS	NS	NS	NS
	Sediment	(mg/kg)	11.1	7.9	11.8	NS	NS
1994	Water	(mg/L)	0.023	0.023	0.039	NS	NS
	Soil	(mg/kg)	U (0.45)	0.92	U (0.44)	NS	NS
	Sediment	(mg/kg)	9.65	2	19.3	NS	NS
1995	Water	(mg/L)	0.1	0.2	0.077	NS	NS
	Soil	(mg/kg)	2.2	0.86	4	NS	NS
	Sediment	(mg/kg)	7.75	3.85	5.95	NS	NS
1996	Water	(mg/L)	0.04	0.11	0.085	0.016	NS
	Soil	(mg/kg)	0.89	0.76	0.67	1.3	NS
	Sediment	(mg/kg)	1.6	5.3	10.5	5	NS
1997	Water	(mg/L)	0.11	0.02	0.021	0.0066	NS
	Soil	(mg/kg)	0.49	0.46	8.1	3.1	NS
	Sediment	(mg/kg)	2.2	4.35	3.25	2.65	NS
1998	Water	(mg/L)	0.12	0.054	0.099	0.0088	0.026
	Soil	(mg/kg)	1.1	1	U (0.41)	1.2	2.3
	Sediment	(mg/kg)	4.2	17	38	2.5	17.5
1999	Water	(mg/L)	0.24	0.11	0.01	0.006	0.02
	Soil	(mg/kg)	0.59	0.43	U (0.47)	2.6	U (0.48)
	Sediment	(mg/kg)	6.7	2.7	4.2	4.4	8.1

Note: Sediment concentrations reflect a mean of the upstream sample and the downstream sample

NS - Not Sampled

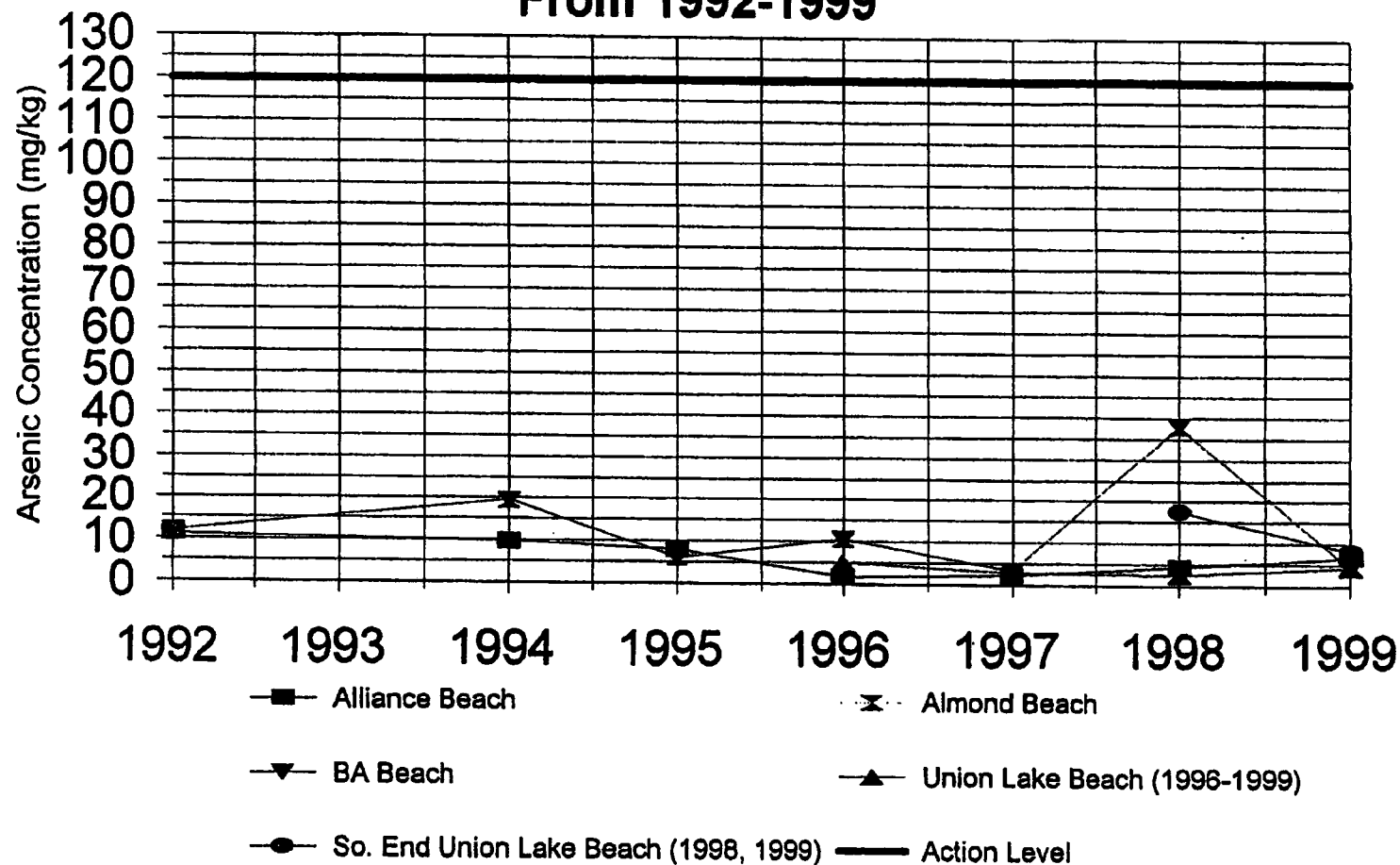
U - not detected at indicated concentration

Action Limit: Soil/Sediment - 120 mg/kg, Water - .05 mg/L

mg/L - milligrams per Liter

mg/kg - milligram per kilogram

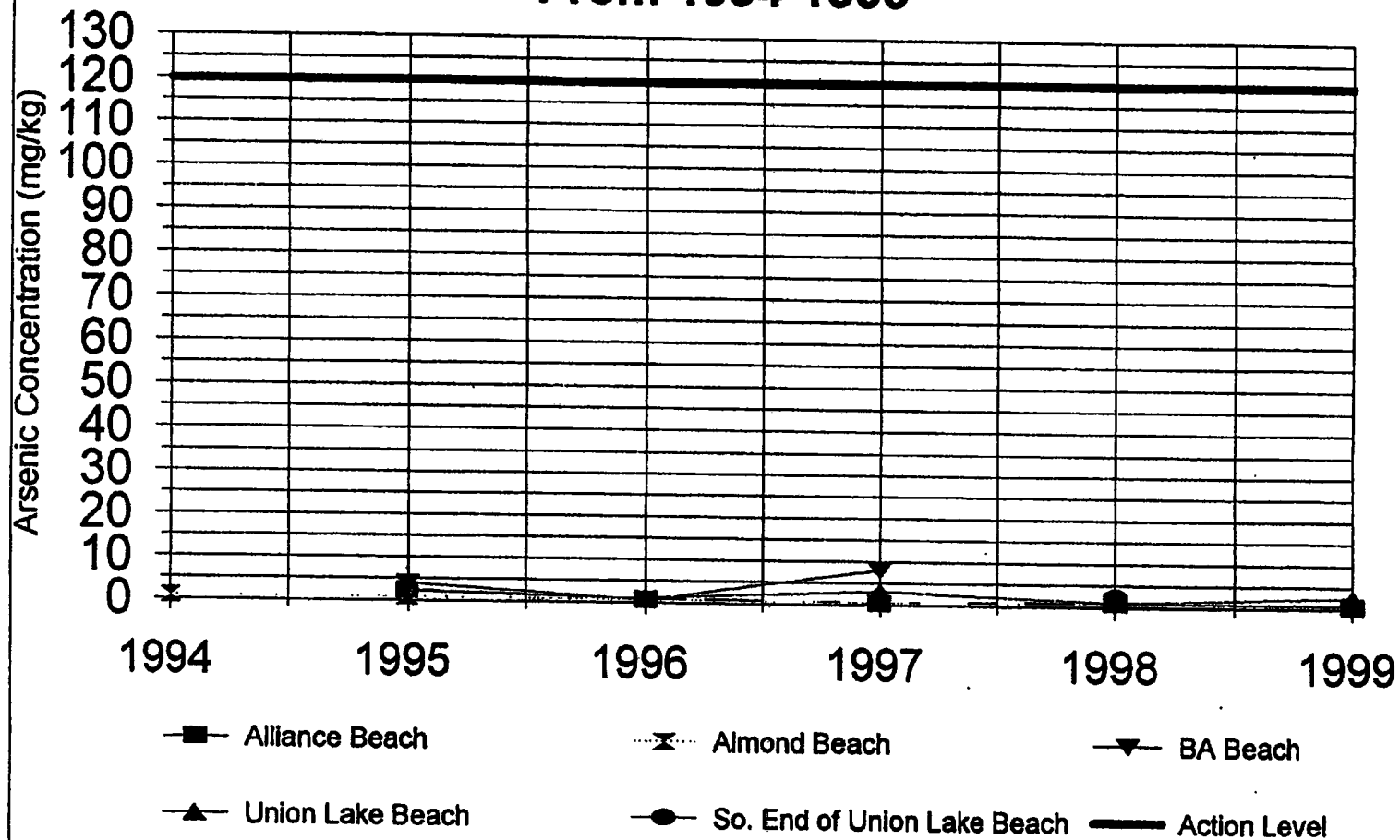
Arsenic Concentrations In Sediment From 1992-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
98-04-0022
W.G. # 03347-143-001-3195-01

FIGURE 2
ARSENIC CONCENTRATIONS IN SEDIMENT FROM 1992 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999

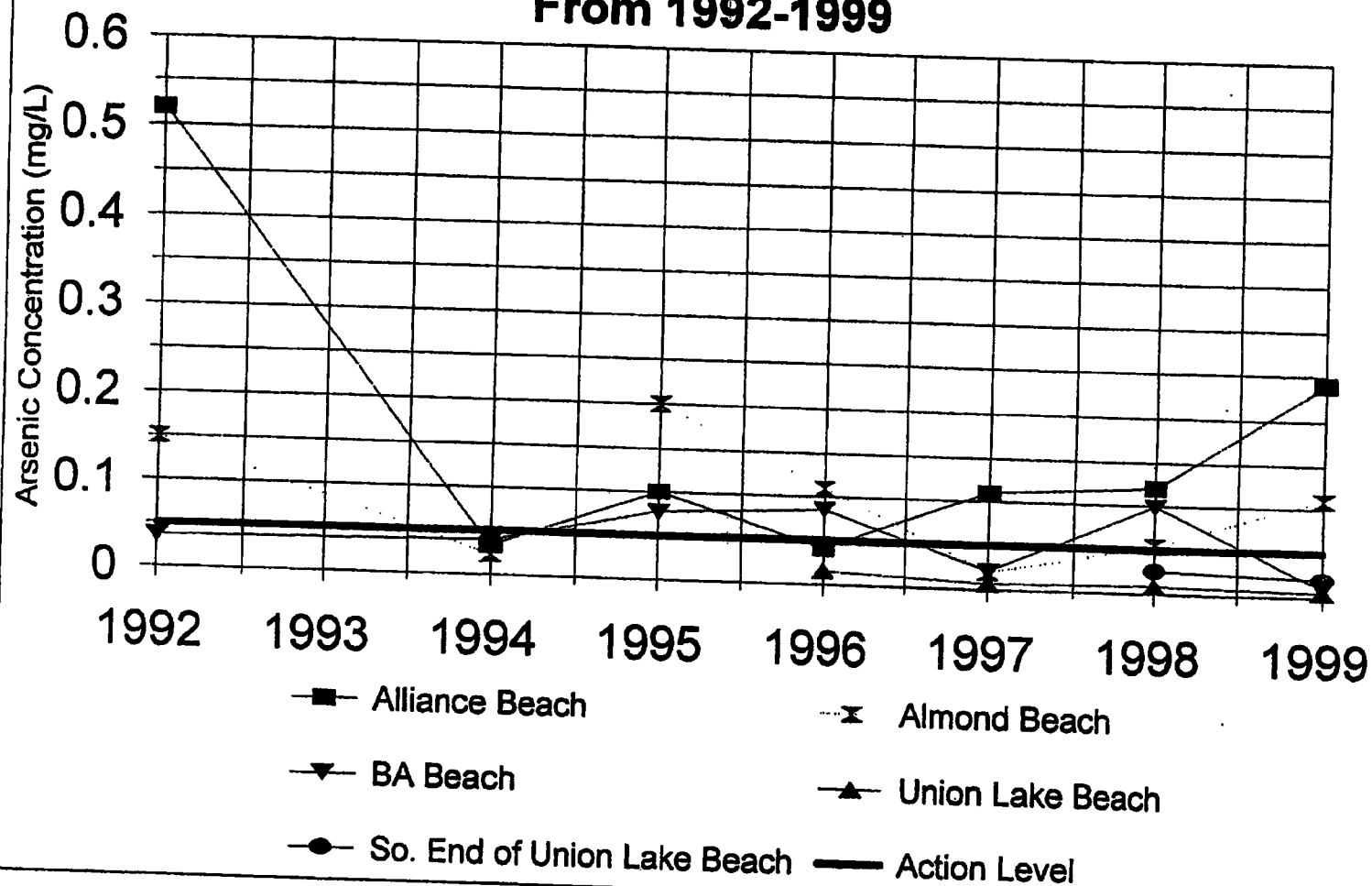
Arsenic Concentrations in Soil From 1994-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
06-CA-0022
W.D. # 03347-143-001-3105-01

FIGURE 3
ARSENIC CONCENTRATIONS IN SOIL FROM 1994 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999

Arsenic Concentrations in Water From 1992-1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
00-C4-0022
W.O. # 02347-143-001-3185-01

FIGURE 4
ARSENIC CONCENTRATIONS IN WATER FROM 1992 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999

APPENDIX A
Field Documentation
Vineland Chemical Site
Final Report
May 1999

4/29/99

Vineyard
House #1 across from site

note: started at 8:40 AM and continued
pH - 6.1
cond - .095
turb - 0
DO - 11.32
Temp - 14°C
Sal - 0

House #2 Adjacent to site
509 Wheat Rd
Mrs Brown

pH - 8.69
cond - .085
turb - 0
DO - 11.24
Temp - 13.2
Sal - 0

Almond Beach

Bridge

sid

flow

X H₂O

sal - 0

5.7X5.5m
Beach Area

pH - 6.4
cond - .077
turb - 0
DO - 8.66
Temp - 13.5
sal - 0

Alliance Beach

Flow →

st-1

x H₂O

st-2

x soil
Beach Area

pH = 6.3

Cond = .079

Turb = 0

DO = 8.91

Temp = 15.1

Sal = 0

BA Beach

Flow ←

st-1

x H₂O

st-2

x soil

Beach Area

pH = 5.85

Cond = .079

Turb = 0

DO = 9.65

Temp = 14.6

Sal = 0

So. Encl. Union Lake

sd

x H₂O

gummy
line

x soil

planning
sign

Beach Area

pH - 5.74

Cond. - .093

Turb - 0

DO - 9.4

Temp - 15.3

Sal - 0

Union Lake S+I Club

sd-D

x H₂O

sd-L

Clubhouse

x Soil

Beach Area

pH - 5.74

Cond. - .091

Turb - 0

DO - 9.65

Temp - 16.9

Sal - 0

Union Lake T+S CLUD

potable H₂O

7.0

pH - 7.9

cond - 0.61

Turb - 0

DO - 11.50

Temp - 14.8

Sal - 0

APPENDIX B
Analytical Report
Vineland Chemical Site
Final Report
May 1999

ANALYTICAL REPORT

Prepared by
Roy F. Weston, Inc.

Vineland Chemical Site
Vineland, Cumberland County, New Jersey

May 1999

EPA Work Assignment No. 3-195
WESTON Work Order No. 03347-143-001-3195-01
EPA Contract No. 68-C4-0022

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Introduction

REAC in response to WA #3-195, provided analytical support for environmental samples collected from the Vineland Chemical Site located in Vineland, Cumberland County, New Jersey as described in the following table. The support also included QA/QC, data review, and preparation of an analytical report containing a summary of analytical methods, results, and QA/QC results.

The samples were treated with procedures consistent with those specified in SOP #1008.

Chain of Custody	Number of Samples	Sampling Date	Date Received	Matrix	Analysis	Laboratory
03503	5	4/29/99	4/30/99	Water	Arsenic	REAC
	15			Soil		
03504	4			Water		
	2			Soil		

CASE NARRATIVE

Data Package 1181

The arsenic (As) percent recoveries for soil samples A19256MS (46%) and A19256MSD (48%) exceeded the QC limits. The As results for soil samples A19251, A19252, A19253, A19255, A19256, A19257, A19259, A19260, A19261, A19263, A19264, A19265, A19267, A19268, A19269, A19274 and A19275 are considered estimated.

Summary of Abbreviations

AA	Atomic Absorption		
B	The analyte was found in the blank		
BFB	Bromofluorobenzene		
BPQL	Below the Practical Quantitation Limit		
BS	Blank Spike		
BSD	Blank Spike Duplicate		
C	Centigrade		
D	(Surrogate Table) this value is from a diluted sample and was not calculated (Result Table) this result was obtained from a diluted sample		
CLP	Contract Laboratory Protocol		
COC	Chain of Custody		
CONC	Concentration		
CRDL	Contract Required Detection Limit		
CRQL	Contract Required Quantitation Limit		
DFTPP	Decafluorotriphenylphosphine		
DL	Detection Limit		
E	The value is greater than the highest linear standard and is estimated		
EMPC	Estimated maximum possible concentration		
J	The value is below the method detection limit and is estimated		
ICAP	Inductively Coupled Argon Plasma		
IDL	Instrument Detection Limit		
ISTD	Internal Standard		
MDL	Method Detection Limit		
MQL	Method Quantitation Limit		
MI	Matrix Interference		
MRL	Method Reporting Limit		
MS	Matrix Spike		
MSD	Matrix Spike Duplicate		
MW	Molecular Weight		
NA	either Not Applicable or Not Available		
NC	Not Calculated		
NR	Not Requested		
NS	Not Spiked		
% D	Percent Difference		
% REC	Percent Recovery		
PQL	Practical Quantitation Limit		
PPBV	Parts per billion by volume		
QL	Quantitation Limit		
RPD	Relative Percent Difference		
RSD	Relative Standard Deviation		
SIM	Selected Ion Mode		
U	Denotes not detected		
W	Denotes weathered analyte, the results should be regarded as estimated.		
m	cubic meter	kg	kilogram
L	liter	g	gram
dL	deciliter	cg	centigram
mL	milliliter	mg	milligram
μL	microliter	μg	microgram
ng	nanogram	pg	picogram

* denotes a value that exceeds the acceptable QC limit

Abbreviations that are specific to a particular table are explained in footnotes on that table

Revision 7/9/98

Analytical Procedure for Arsenic in Water

Sample Preparation

A representative 45 mL aliquot of each sample was mixed with 5.0 mL concentrated nitric acid, placed in an acid rinsed Teflon container, capped with a Teflon lined cap, and digested according to SW-846, Method 3015 in a CEM MDS-2100 microwave oven, which was programmed to bring the samples to 160 +/- 4°C in 10 minutes (first stage) and slowly rise to 165-170°C in the second 10 minutes (second stage). After digestion, samples were allowed to cool to room temperature and were transferred to polyethylene bottles. Samples were analyzed for all metals, except mercury, by US EPA SW-846, Method 7000 Atomic Absorption (AA) or Method 6010 Inductively Coupled Argon Plasma (ICAP) procedures.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each analytical batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) sample were also processed for each analytical batch or every 10 samples.

Analysis and Calculations

The AA and ICAP instruments were calibrated and operated according to SW-846, Method 7000/7470/6010 and the manufacturer's operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB), and QC check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) standards were run after every 10 samples to verify proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter (µg/L) were read directly from the read-out systems of the instruments. ICAP and Mercury results were taken directly from instrument read-outs. The ICAP results were corrected for digestion volume (45 mL sample + 5 mL nitric acid) prior to instrument read-out; AA read-outs (excluding Mercury) were externally corrected for digestion volume ($1.1111 \times \text{AA read-out}$).

For samples that required dilution to fall within the instrument calibration range:

$$\mu\text{g/L metal in sample} = A [(C+B) / C]$$

where:

- A = direct read-out (ICAP and Mercury)
- A = corrected read-out (AA)
- B = acid blank matrix used for dilution, mL
- C = sample aliquot, mL

Results of the analyses are listed in Table 1.1.

Analytical Procedure for Arsenic in Soil

Sample Preparation

A representative 1-2 g (wet weight) sample, weighed to 0.01 g accuracy, was mixed with 10 mL 1:1 nitric acid, placed in a clean beaker and digested in nitric acid and hydrogen peroxide according to SW-846, Method 3050. The final reflux was either nitric acid or hydrochloric acid depending on the metals to be determined. After digestion, the samples were allowed to cool to room temperature and transferred to 100 mL volumetric flasks and diluted to volume with ASTM Type II water. The samples were analyzed for all metals, except mercury, by USEPA SW-846, Method 7000 (Atomic absorption) or Method 6010 (Inductively Coupled Argon Plasma-ICAP) procedures.

A separate sample was used to determine total solids.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) were analyzed for each batch or for every ten samples.

Analysis and Calculations

The instruments were calibrated and operated according to SW-846, Method 7000/7471/6010 and the manufacturers operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB) and quality control check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) were run after every ten samples to assure proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter ($\mu\text{g/L}$) were taken from the read-out systems of the Atomic Absorption instruments. The results were converted to milligrams per kilogram (mg/kg) by correcting the reading for the sample weight and percent solids. The ICAP results (mg/kg) were corrected for sample weight prior to instrument read-out; the instrument read-out was then corrected for percent solids.

Final concentrations, based on wet weight are given by:

$$\text{mg metal/kg sample} = [(AxV)/W] \times DF \times CF$$

where:

A = Instrument read-out ($\mu\text{g/L}$, AA; mg/kg , ICAP)
V = final volume of processed sample (mL, AA; 1.00 ICAP)
W = weight of sample (g, AA; 1.00 ICAP)
DF = Dilution Factor (1.00 for no dilution)
CF = conversion factor (0.001, AA; 1.00, ICAP)

For samples that required dilution to be within the instrument calibration range, DF is given by:

$$DF = (C+B)/C$$

where:

B = acid blank matrix used for dilution (mL)
C = sample blank aliquot (mL)

Final concentrations, based on dry weight, are given by:

$$\text{mg/kg(dry)} = [\text{mg/kg (wet)} \times 100] / S$$

where

S = percent solids

The results are listed in Table 1.2.

Table 1.2 Results of the Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site
Results Based on Dry Weight

Parameter: Analysis Method:		Arsenic AA-Furnace		
Client ID	Location	Percent Solids	Conc mg/kg	MDL mg/kg
Method Blank	Lab	NA	U	0.50
A19251	Almond-S	82.91	0.43	0.39
A19252	Almond-Sd-U	76.51	3.4	0.44
A19253	Almond-Sd-D	80.00	1.9	0.41
A19255	Alliance-S	87.68	0.59	0.41
A19256	Alliance-Sd-U	82.49	10	0.42
A19257	Alliance-Sd-D	85.09	3.4	0.41
A19259	BA Beach-S	99.53	U	0.47
A19260	BA Beach-Sd-U	79.54	6.6	0.41
A19261	BA Beach-Sd-D	77.98	1.7	0.44
A19263	So. End Union Lake-S	99.57	U	0.48
A19264	So. End Union Lake-Sd-U	74.95	11	0.38
A19265	So. End Union Lake-Sd-D	71.90	5.1	0.42
A19267	Union Lake-S	88.25	2.6	0.41
A19268	Union Lake-Sd-U	77.54	6.0	0.47
A19269	Union Lake-Sd-D	82.51	2.8	0.42
A19274	Field Blank-S	100.00	U	0.48
A19275	Field Blank-Sd	100.00	U	0.48

Table 1.1 Results of the Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Parameter:
Analysis Method:

Arsenic
AA-Furnace

Client ID	Location	Conc ug/L	MDL ug/L
Method Blank	Lab	U	2.2
A19254	Almond-SW	110	2.2
A19258	Alliance-SW	240	2.2
A19262	BA Beach-SW	11	2.2
A19266	So. End Union Lake-SW	15	2.2
A19270	Union Lake-SW	5.8	2.2
A19271	Union Lake-P	U	2.2
A19272	House #1-P	U	2.2
A19273	House #2-P	U	2.2
A19276	Field Blank-SW	U	2.2

QA/QC for Arsenic

Results of the QC Standard Analysis for Arsenic in Water

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.1, was 97 and within the 95% confidence interval limit.

Results of the MS/MSD Analysis for Arsenic in Water

Sample A19258 was chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.2, were 76 and 99. Both recoveries were within QC limits. The relative percent difference (RPD), also listed in Table 2.2, was 27 and outside the QC limits.

Results of the Blank Spike Analysis for Arsenic in Water

The percent recovery for the blank spike arsenic, listed in Table 2.3, was 99 and within QC limits.

Results of the QC Standard Analysis for Arsenic (Soil)

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.4, was 96 and within the 95% confidence interval limits.

Results of the MS/MSD Analysis for Arsenic in Soil

Samples A19255, A19256, and A19257 were chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.5, ranged from 46 to 83. Four out of 6 recoveries were within QC limits. The relative percent differences (RPDs), also listed in Table 2.5, ranged from 2 to 10. All 3 RPDs were within QC limits.

Results of the Blank Spike Analysis for Arsenic in Soil

The percent recovery for the blank spike arsenic, listed in Table 2.6, was 95 and within QC limits.

**Table 2.1 Results of the QC Standard Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site**

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	04/30/99	TMAA #1	48.53	50	41.9-55.9	97

Table 2.2 Results of the MS/MSD Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Sample ID: A19258

Metal	Sample Conc µg/L	MS Spike Added µg/L	MS Conc µg/L	MS % Rec	MSD Spike Added µg/L	MSD Conc µg/L	MSD % Rec	RPD	Recommended QC Limits	
									% Rec	RPD
Arsenic	244	55.6	299	99	55.6	288	76	27 *	75-125	20

**Table 2.3 Results of the Blank Spike Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site**

Metal	Spiked Conc ug/L	Recovered Conc. ug/L	% Recovery	Recommended QC Limit % Rec
Arsenic	55.6	55.1	99	75-125

Table 2.4 Results of the QC Standard Analysis for Arsenic (Soil)
WA# 3195 Vineland Chemical Site

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	05/03/99	TMAA #1	48	50	41.9-55.9	96

Table 2.5 Results of the MS/MSD Analysis for Arsenic in Soil
 WA# 3195 Vineland Chemical Site
 Results Based on Dry Weight

Sample ID: A19255										
Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits	
									%Rec	RPD
Arsenic	0.587	4.04	3.81	75	4.19	3.79	76	2	75-125	20

Table 2.5 (cont.) Results of the MS/MSD Analysis for Arsenic in Soil
 WA# 3195 Vineland Chemical Site
 Results Based on Dry Weight

Sample ID: A18256										
Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits	
									%Rec	RPD
Arsenic	10.4	4.36	12.4	46	4.39	12.5	48	4	75-125	20

Table 2.5 (cont.) Results of the MSMSD Analysis for Arsenic in Soil
 WA# 3195 Vineland Chemical Site
 Results Based on Dry Weight

Sample ID: A19257										
Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits	
									%Rec	RPD
Arsenic	3.44	4.29	6.99	83	4.32	6.66	75	10	75-125	20

**Table 2.6 Results of the Blank Spike Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site**

Metal	Spiked Conc mg/kg	Sand Blk Conc. mg/kg	Recovered Conc. mg/kg	% Recovery	Recommended QC Limit % Rec
Arsenic	4.95	U	4.71	95	75-125

CHAIN OF CUSTODY RECORD
Project Name: Wildland Chemical
Project Number: 03247-148-001-3105-01

Project Number: 03347-143-001-3195-01
RFW Contact: Don Boule Phone: 732-494-4004

No: 03503

043099-

Sample Identification

SHEET NO. 1 OF 2
Analyses Requested

REC#	Sample No.	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	Analysis
-109	A19251	Almond - S	S	4/29/99	1	For jar / y.c.	Asst. <input checked="" type="checkbox"/>
110	A19252	Almond - Sd-U	Sd				
111	A19253	Almond - Sd-D	Sd				
112	A19254	Almond - Sd-U	Sd			16 gms / 100 gms H ₂ O	
113	A19255	Alliance - S	S			80 gms / y.c.	
114	A19256	Alliance - Sd-U	Sd				
115	A19257	Alliance - Sd-D	Sd				
116	A19258	Alliance - Sd-U	Sd		3	16 gms / 100 gms H ₂ O	
117	A19259	BA Brack - S	S		1	80 gms / y.c.	
118	A19260	BA Brack - Sd-U	Sd				
119	A19261	BA Brack - Sd-D	Sd				
120	A19262	BA Brack - Sd-U	Sd			16 gms / 100 gms H ₂ O	
121	A19263	BA Brack - Sd-U	Sd			80 gms / y.c.	
122	A19264	BA Brack - Sd-U	Sd				
123	A19265	BA Brack - Sd-D	Sd				
124	A19266	BA Brack - Sd-U	Sd			16 gms / 100 gms H ₂ O	
125	A19267	BA Brack - Sd-U	Sd			80 gms / y.c.	
126	A19268	BA Brack - Sd-U	Sd				
127	A19269	BA Brack - Sd-D	Sd				
128	A19270	BA Brack - Sd-U	Sd			16 gms / 100 gms H ₂ O	

SW - Sediment	PW - Potable Water	S - Soil	* MS/MSD
DS - Drum Solids	GW - Groundwater	W - Water	
DL - Drum Liquids	SW - Surface Water	O - Oil	
X - Other	SL - Sludge	A - Air	

全

FOR SUBCONTRACTING USE ONLY

FROM CHAIN OF

CUSTODY #

[illegible]

EPA Contract 68-C4-0022

CHAIN OF CUSTODY RECORD

RFW Contact: Gen Royce Phone: 732-494-4004

No: 03504

SHEET NO. 1 OF 2

043099-

Sample Identification

Analyses Requested

[illegible]

Matrix:

SD -	Sediment	PW -	Potable Water	S -	Soil
DS -	Drum Solids	GW -	Groundwater	W -	Water
DL -	Drum Liquids	SW -	Surface Water	O -	Oil
X -	Other	SL -	Sludge	A -	Air

Special Instructions:

FOR SUBCONTRACTING USE ONLY

FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished By	Date	Received By	Date	Time	Items/Reason	Relinquished By	Date	Received By	Date	Time
all / analysis	Heather Chaplin	4/22/99	David Angwenyi	4/30/99	8:30am	ALL / analysis	David Angwenyi	4/30/99	Heather Chaplin	4/30/99	7:00

FORM #4

